Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIV. NEW YORK, SATURDAY, AUGUST 27, 1904. No. 9.

ELECTRICAL WORLD AND ENGINEER.

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

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ELECTRICAL WORLD AND ENGINEER.

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The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	.10

Remittances for foreign subscriptions may be made through our European office.
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Entered as second-class mail matter at the New York Post Office.

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GOVERNMENT WIRELESS TELEGRAPHY.

The conclusions of the Government board named to investigate the subject of the control of wireless telegraphy in this country, the details of which were printed in our issue of last week, give short shrift to private control, as might have been expected from the constitution of the board. After dividing up among the Navy, War and Agricultural Departments, what appears to be a reluctant admission is made that there may be special cases where private stations can serve a useful purpose; but even in these cases it is provided that such stations must be licensed and supervised by a Government Department. What this concession amounts to so far as relates to coastwise wireless telegraphy, is rendered plain by language in other parts of the report; for it is asserted as fundamental that the maintenance of a *complete* coastwise system of wireless telegraph by the Navy Department is necessary for the efficient and economical management of the fleets of the United States in time of peace, and for efficient manoeuvering in time of war; and elsewhere, that private stations must not interfere with Government stations necessary to national defence. We can imagine the word "economical" being interpolated by a politic member of the board with a sly wink at his fellows. The balance sheet of a naval wireless establishment at Galveston, for example, would be an interesting exhibit if the question were brought up as to the relative cost in time of peace of wireless naval communications through a naval station and through a private station handling as a commercial venture all classes of wireless business.

That wireless telegraph service in time of war should pass under military control will doubtless be admitted by everyone; for in wartime the useful arts, commerce, civil rights and at times even human rights, have to be subordinated to military exigency. But such régime should not extend to times of peace unless it can be clearly shown that the interests of the nation in times of war would otherwise be jeopardized. In this case we believe that the exact reverse is true, and that coastwise service under private control operated as a business enterprise in times of peace, would, if passed over with its staff to the Government at the outbreak of war, be immeasurably more efficient than a service organized and directed by the war arm of the Government. In Russia it might be maintained that only the military personnel could be trusted in the operation of the service in time of war. We hope that the insistence of the Government board on the practical elimination of all civilian elements from its wireless plans does not imply that in this country a continental military spirit suspicious of civilian classes is in process of development. According to a press dispatch, the report of the wireless board has been approved. This can scarcely be true if approval means that the recommendations are to be enforced without further ado, for it would be most extraordinary if in the United States a branch of national industry were thus to be summarily dealt with by a Government board without any hearing whatever from the interests affected.

ALTERNATING CURRENT TRACTION.

The successful operation of a car in regular service by means of the single-phase motor over the Ballston division of the Schenectady railway, is of more than passing interest to the engineering world, and serves further to confirm the stand taken by those who have maintained that motors of the single-phase type would event-

ually be developed to meet every requirement of electric traction, a stand which at first brought forth unfavorable comment from almost every quarter. It is a singular fact that both the Westinghouse and General Electric Companies have adopted the so-called straight series motor of the compensated type, the machine used by the two companies differing more in mechanical details than in electrical characteristics. This has been the cause of no little surprise, for every indication previously had been that the latter company was committed to the development of the repulsion type of motor. It remains also a matter worthy of comment that both compensated motors were experimented with by Eickemeyer and Steinmetz in 1891 and 1892. That no serious attempts were then made farther to develop motors possessing such valuable characteristics is attributable to the relatively discouraging results obtained with the high frequencies in common use at that time.

One cannot but be impressed with the predominating features of the equipment used on the Ballston railway—its simplicity and the lack of radical change from standard practice. The motor represents what would, perhaps, be considered the very best design for a direct-current series machine, being equipped with the Ryan type balancing coils, no additional means being taken to eliminate sparking except careful proportioning of the armature windings. Plain rheostatic control is used, standard direct-current apparatus being employed for this purpose. Although a frequency of 25 cycles has been adopted, the motors operate in a thoroughly satisfactory manner, without signs of destructive sparking at the commutator. The ability of a motor to operate equally well on direct or alternating-current circuits appears to be considered of paramount importance in the present period of development of alternating-current traction; and the fact that the several types of alternating-current motors now commercially available embody in their design features common to the best of direct-current machines, is encouraging with respect to contemplated extensions of present direct-current systems.

LEGALIZATION OF THE STANDARD OF E.M.F.

Our esteemed contemporary, across the Atlantic, the *Elektrotechnische Zeitschrift*, publishes an official communication from the Reichsanstalt in regard to the proposition of the American Institute of Electrical Engineers for the coming International Electrical Congress at St. Louis to adopt the cadmium cell as a legal standard of e.m.f. It has to be remembered that the Chicago Congress of 1893 defined the international ohm and volt in terms of the corresponding c.g.s. units (the absohm and absampere); but ordained that the concrete international ohm should be the resistance of a specified mercury column and the concrete international ampere, that which deposited silver at a specified rate in a specified silver coulombmeter. It also defined the international volt from the two preceding units by Ohm's law, but ordained that, for practical use, the Clark cell, prepared under definite specifications, might be taken at 1.434 volt. The latter specifications were left to a committee, which has never reported. The various countries legally adopted these resolutions in various ways. In Germany, for example, the ampere is defined by law in terms of the rate of deposition of silver in a specified coulombmeter, conformably with the Chicago Congress resolution. The ohm is also defined as the resistance of the mercury column defined at Chicago. The volt is defined, however, in terms of the ohm and ampere, with no reference to standard cells. The Reichsanstalt points out that it is not only superfluous, but also even incorrect, to define the volt independently, having already defined the ohm and ampere. Moreover, the specifications for the Clark cell were never filed. Furthermore, later determinations have shown that the Clark cell, instead of having 1.434 international volts, as ordained at Chicago, has more nearly 1.433. In fact, the value attributed to the Clark cell by the Reichsanstalt, in terms of the legalized ohm and ampere, is stated to be 1.4328.

It is manifestly the duty, therefore, of the next International Electrical Congress to correct the error of the Chicago definition of the concrete volt. This error is of a practically appreciable magnitude. It represents 1/10 of a volt in 143 volts. Any carefully made laboratory comparison between two voltmeters would be influenced perceptibly by this degree of error, and industrially incandescent lamp contacts are liable to an appreciable money variation in view of such an error, since average life tests of lamps are affected by 1/10 volt. The question is how the error should be corrected. This question affects laboratories all over the world. Only a very few large central laboratories can depend upon the silver coulombmeter. Its technique is tedious, limited in range and liable to error. Although capable of a high degree of reproducible accuracy under definite specifications, it requires very skilled and trained observers to obtain reliable results. It can only be used to standardize or calibrate a standard ammeter by check tests made at rare intervals. On the other hand, a standard cell is very practical, swift in use and portable. It can be used with a potentiometer over a very wide range of voltage, or of current strength, and almost every electrical laboratory depends upon it. It is open to discussion whether the reproducible accuracy of the Clark cell or cadmium cell is equal to that of the silver coulombmeter. Some assert that it is and some deny the proposition. There can be no doubt, however, that if its reproducible accuracy were as great as that of the silver coulombmeter, the two units that ought to be defined concretely, from among the three entering into Ohm's law, should be the volt and ohm rather than the ampere and ohm, i. e., the standard cell and the standard resistance coil rather than the silver plating bath and the standard resistance coil.

There are several ways in which the Chicago Congress resolutions might be corrected for the error in the magnitude of the mercury cell. The first is to drop out the concrete ampere and correct the Clark cell voltage. The second is to substitute the cadmium cell for the mercury cell, ignoring the redundancy of three legalized concrete magnitudes, only two of which are independent. There are various possible intermediate propositions. The objections offered by the Reichsanstalt to any of the proposals is that the e.m.f. of Clark and Weston cells is not yet known to a sufficient degree of reproducible accuracy to warrant upsetting already existing legislation, and that it is undesirable to legalize a standard cell e.m.f. until all countries are prepared to adopt the change. Admitting all the force of the Reichsanstalt arguments against taking action on this matter at St. Louis, nevertheless, it is urged by many that the present situation is intolerable and cannot be left unchanged without involving yet greater difficulties. Since it is admitted on all sides that the value of e.m.f., authoritatively existing at this time from the Chicago Congress, is wrong nearly 1 part in 1,000; whereas Clark cells are reproducible probably at least to 1 part in 5,000, and readily comparable among each other to 1 part in 50,000, something should be done to amend the error.

It is, of course, impossible to foretell what action will be taken by the Chamber of Government Delegates at St. Louis. A possible course, however, which might meet with general approbation would be to adopt an e.m.f. for the Clark cell either sensibly or exactly in accordance with the Reichsanstalt estimate and to adopt this Clark cell provisionally as a secondary standard, subordinate to the international ohm and ampere. In photometry, for example, so-called fundamental or primary standards are employed; but secondary

standards are also capable of being recognized, or even of being legally adopted. Moreover, it would be possible temporarily to adopt a Clark cell secondary concrete standard of e.m.f. as dependent upon the international ampere and ohm with a provisional value of say 1.433 volts, and also a provisional ratio of the mercury cell e.m.f. to the cadmium cell e.m.f. This plan would enable all users of mercury or cadmium standard cells in laboratories all over the world to take an international provisional value for their e.m.f. It would in no way affect the existing legal situation as to the international units in countries like Germany, where the ampere and ohm are already enthroned. It would leave it open to any future International Electrical Congress either to amend the provisional e.m.f. value of the secondary standard cell, or to make the standard cell the fundamental concrete or primary unit. If, on the other hand, the St. Louis Congress takes no action in the matter, we shall find ourselves in the awkward predicament that whereas certain countries, notably the United States, Canada and France, have already legalized the Clark cell as 1.434 volt, electrical engineers will probably actually take it as 1.433; or, if they should conform to the law, they would involve corresponding appreciable errors and confusion in their electrical work.

As to the suggestion of the Reichsanstalt that a World's Fair is not a suitable place for the discussion of such questions as international legal standards, the question arises why every International Electrical Congress hitherto held has been in connection with a World's Fair? It is easier to collect a number of men together at an International Exposition than on the desert of Sahara, or at the source of the Nile. The delegates sitting behind closed doors, as at Chicago in the past, or at St. Louis in the future, can think as contentedly in a large city as in a country village. Of course, where, is at Paris in 1900, the actions of the Chamber of Government Delegates is partaken of by the Congress at large, or by a section thereof, there is danger of erratic and hasty action being taken by a large assembly upon matters that ought to be left to a small committee. In fact, it would be better if the delegates invited to such a Congress were limited to one from each Government. In that event, the small committee thus formed could readily be convoked anywhere or at any time without much difficulty.

A PROBLEM IN ELECTRIC RAILROADING.

The relations between steam and electric roads are a continual source of difficulty, and just at the present time the situation is accentuated by a strong disposition on the part of the former to buy up the latter and thus, initially, to check the competition that has in certain places become acute. At first the electric road was merely a street railway, having no relation to the ordinary railroad save as it carried passengers to and from the various stations. As soon, however, as the interurban and suburban lines went into business, it became painfully evident that competition was alive; and it took only a few seasons to demonstrate that a well-managed electric road could, by its advantage of position, win out nearly every time in the contest for traffic. Then the opposition of the steam roads to electrical traction enterprises began to develop. For a long time it was confined to determined lobbying and dilatory tactics of one sort or another designed to defeat or hold up charters. This warfare, carried on boldly, was often like that earlier waged between rival steam roads, but as regards the public it was on a slightly different basis. It has not been considered good policy to allow indiscriminate paralleling of lines of transportation. A railroad is a serious investment and unless public convenience demands extra facilities the multiplication of roads may work injustice. In the case, however, of electric roads which do a very extensive local business and by their new routes and frequent stopping places do actually add greatly to public transportation facilities, there was good reason for granting numerous and liberal charters. Even the most desperate lobbying and blocking could not be relied upon at all times, save in some subservient regions where government by lobbying is notorious. Therefore the steam roads, facing serious competition, have adopted the shrewd, broader policy of buying up, acquiring charters where feasible, and annexing completed roads when necessary.

Having thus entered the electric railway business, what are the steam roads going to do? There seems to be considerable doubt in financial circles as to whether they can conduct an electric business to advantage, and instances of failure have been freely cited. But broadly the electric traction business in its suburban and interurban features is one in which general railway experience should count for much. In fact, it needs this very kind of experience and we know of some admirably operated electric lines under steam railway management. A wideawake railroad man ought to make the best kind of a manager for a long electric line doing interurban business, rather better, we think, than a man trained purely in the street railway business. This being so, why should not steam roads go successfully into the electric railway business? Why should there be failure to make proper earnings? We think that those who make much of such early failures do not properly appreciate the situation. The object of a railway system when worked on a sound basis is to earn dividends on its whole investment. If it can operate feeders for its general system so as to develop traffic on a paying basis, its rate of earning on the price paid for a particular feeder is not a matter of much consequence. If by buying up an electric line which otherwise would be a serious competitor it can save a big inroad upon passenger traffic, the interests of economy might be best served by running just one car a day to save the franchise. Steam roads are not buying electric branches merely as investments, but to keep control of the business, and if they lose in one place they may make in another, and by holding the monopoly of transportation can very easily recoup contingent losses up to any reasonable amount. There is no sentiment about the matter. It is plain business conducted on the principle that is too often the basis of modern business methods: Stifle competition at any cost and get square after you have command of the market.

We have no doubt at all that some of the properties acquired by steam roads can be made to pay well as individual enterprises, and that they can be skillfully and economically operated by their new owners. But as investments on their own behalf some of the new owners, we fear, do not consider them. They have become part of a great transportation system, to be so operated as to give the best returns for the system as a whole, and thus may or may not mean individual profit. The thing in which the public is actually interested is the result of this policy upon the service in a given locality. If an interurban road is bought up and the operation of it is such as to increase the total facilities for transportation between its terminals, the public certainly has no quarrel with the owners. If, however, the electric road is bought for the purpose of removing the facilities arising from sharp competition, then the public has a right to kick and complain and to take vigorous action. So long as people are contented to sit quietly about and take what is accorded them without complaint, they have no reason to object to curtailment of transportational or other privileges. But the time will surely come when the consolidation of competitive enterprises will be no safe, or easy matter to accomplish. When that time comes, the electric roads will be developed at their full value to the public.

Arrival and Entertainment of Foreign Electrical Engineers.

For some weeks past electrical engineers from Europe visiting the St. Louis Exposition and intending to participate in the International Electrical Congress have been arriving on these shores, and due note has been made in these pages of their presence. The first large party organized for the purpose reached New York City on August 24, when 30 members of the Associazione Elettrotecnica Italiana arrived on the *Princess Irene* direct from Italy, headed by President Ascoli, who is accompanied by his wife. This party was met by Mr. J. W. Lieb, Jr., chairman of the General Reception Committee of the American Institute of Electrical Engineers; Mr. T. C. Martin, chairman of the New York Reception Committee, and Messrs. C. W. Rice and C. de Muralt, members of the committee. The party were taken in carriages to the Park Avenue Hotel, from Hoboken dock, passing en route the Garibaldi statue in Washington Square. The second Italian contingent from this society is due to land from the *Deutschland* on August 25. President Gray and Secretary Lloyd, of the British Institution of Electrical Engineers, are due this week, also at New York, by the *Celtic*.

The Institute headquarters are to be opened at the Waldorf-Astoria on Thursday, August 25, with a reception, and thereafter for a week, until they go on to Boston to meet the party of about 100 members of the British Institution of Electrical Engineers landing there, the Italians will be in the hands chiefly of the local committee of their own society. The Institute Reception Committee, however, gives them a trip up the Hudson to inspect West Point Military Academy on Saturday, August 27. The departure for Boston is made on Thursday, September 1. For the intervening period their local committee, Mr. J. W. Lieb, Jr., chairman, has laid out a pleasant series of trips, excursions, inspections, etc., including some of the points of electrical interest around New York, a visit to the Edison Laboratory, a lunch at the Crocker-Wheeler factory, etc. The New York Edison Company is also extending hospitalities in generous fashion. Moreover, on Sunday, August 28, the Italian Chamber of Commerce and the Dante Alighieri Society give the Italian visitors a banquet at the Hotel Savoy, when the Italian Ambassador will be present, while on Tuesday, August 30, Chairman Lieb gives them an "Al Fresco" dinner at the Claremont, Riverside Drive. The visits in New York will include the local Bell telephone system and Coney Island.

After being entertained elaborately at Boston, the consolidated Anglo-Italian party, some 150 strong, will reach New York, on Sunday morning, September 4, and another series of entertainments will begin. The party from Boston will arrive by Sound steamer at the Fall River Line pier, No. 19, Hudson River, about 7 to 7.30 a.m., Sunday, September 4. The New York Reception Committee has made arrangements to transfer the guests from the boat, on Sunday morning, direct to their hotels, by conveyances specially provided, and their baggage will also be transferred for them so as to relieve them of all necessity of checking and waiting for it. Sunday morning will be left free for rest and recreation, church attendance, inspection of the city, etc., and guests and participating members of the Institute are invited to visit and register at the official Institute and committee headquarters, Suite No. 116-117, first floor, adjoining State Apartments, Waldorf-Astoria, these headquarters being open for the work of the committee from August 29 to September 6, inclusive. At the headquarters necessary tickets and badges will be distributed and all information given by the secretaries and committee in charge.

On Sunday afternoon, September 4, by generous invitation of J. G. White, Esq., member of the committee, a special trip will be given by steamer *Richmond* of the Starin Transportation Line, to view the scenery of the Hudson River. Mr. White and the committee are desirous that as many members of the Institute (with ladies) as possible shall participate in this trip and assist in extending hospitalities to the friends from abroad. The steamer will await the party at the foot of West Thirty-fifth Street, Hudson River, and all intending to go should be aboard not later than 1.45, as start will be made promptly at 2 p.m. The trip up the Hudson will extend as far as tide and weather permit, and buffet luncheon will be served immediately after the boat leaves the dock. The return trip will include the famous Lower Bay of New York and part of the course of the International Yacht Races. Believing that all the visitors would like to see the unique electric lighting effects of Coney Island, Mr. White has arranged to extend the trip to that point, the steamer to dock at one of the piers near "Dreamland." To this, the newest spectacular resort at Coney Island, the party will be admitted, and all will be furnished also with coupons of admission for three of the most attractive "features" or entertainments.

On Monday (Labor Day), September 5, visitors and all members of the Institute desiring to participate are invited to inspect the new Subway. The party will assemble at 9.15 a.m. sharp on the steps of the City Hall, in order to take special train furnished courteously by the Interborough Rapid Transit Company, starting from the City Hall station at 9.30 a.m. This train will run up the west side subway to the Fifty-ninth Street and Columbus Circle station, at which the party will disembark to proceed to the new Fifty-ninth Street power house of the Interborough Company. At 11 a.m. a special steamer of the Long Island Railroad Company will be boarded at the Fifty-eighth Street pier of the Interborough Company and the party will then proceed up the Hudson River to the Kingsbridge power plant of the New York Central Railway Company. The New York Central & Hudson River Railroad Company and the Western Union Telegraph Company have also placed large tugs at the disposal of the committee for transportation purposes, and Mr. Charles G. Curtis has loaned the committee the turbine yacht *Revolution*, to accompany the excursion, so that guests can inspect her operation en route. The party will pass by the Ship Canal to the Harlem River, and at 12.30 p.m., will leave the Kingsbridge plant for the Ninety-sixth Street power house of the New York City Railway Company. During this part of the trip a light collation will be served. At 2 p.m. the party will leave Ninety-sixth Street for the Seventy-fourth Street, or Manhattan Elevated plant of the Interborough Company, on the East River; and at 3 p.m. will leave that point for the Thirty-eighth Street station of the New York Edison Company. After visiting this center of generation and distribution of current for light and power all over Manhattan Island, the party will disband. Data in regard to each plant will be found in the New York Electrical Handbook given to each guest, one of a series of ten books, for the ten cities visited on the circular tour arranged for the engineers from abroad by the Institute.

On the evening of Monday, September 5, the American Institute of Electrical Engineers, with the co-operation of the New York Reception Committee, will give a banquet to the Institution of Electrical Engineers, to the visiting officers and members of the Associazione Elettrotecnica Italiana and other friends from abroad, at the Waldorf-Astoria, at 7 p.m., in the grand ballroom, preceded by a reception in the Astor Gallery at 6.30 p.m. As is the custom at Institute dinners, the presence of ladies is especially welcomed. The seating arrangements provide for the accommodation of eight persons at each table. The tickets with wine are $9 for members and $6 for ladies. In view of the fact that the special train for St. Louis leaves early next morning, the speaking will be limited and brief, and the affair will close at an hour not later than 11 p.m. The visitors from abroad will be the guests of the Institute and the committee. A full attendance of members of the Institute, with ladies, is earnestly requested, upon this representative and official occasion, to do honor to the Institute's foreign guests.

The European visitors will reach New York on the scheduled return trip on September 21 at 5.30 p.m., leaving two or three days for miscellaneous visiting and sightseeing in New York City. The Reception Committee will be in session at the Institute headquarters at the Waldorf and at 95 Liberty Street, and will do all in its power to entertain its guests before they sail for home. Mr. T. A. Edison, member of the committee, has kindly extended the hospitality of his laboratory and shops at Orange, N. J., and desires to entertain the English visitors there at lunch. The committee proposes, therefore, if agreeable to its guests, to visit the laboratory by special train, September 22 or 23, as may be found most convenient.

It may be mentioned with regard to the International Electrical Congress that over 1,900 adhesions have now been recorded and that some 1,500 members have already paid their dues of $5. About 80 papers are already in type. The transactions, which will be secured by members of the Congress without extra cost, will be available for purchase at $10, but no guarantee is made as to the possibility of any non-members thus obtaining them. This set of transactions already bids fair to be one of the most interesting and valuable ever issued in such a connection as there will probably be at least 150 papers in all by well-known authorities.

Multiple Control of Press Motors in San Francisco.

BY WYATT H. ALLEN.

THE organization of the Mutual Label & Lithograph Company, of San Francisco, in 1900, was the result of a combination of the interests of three concerns engaged in the manufacture of labels and lithographic work in general. The logical outcome of such a merger is usually a combined manufacturing establishment, and this case was no exception to the rule. Many of the presses previously in use were moved to a new building, erected especially for the company, and plans were made for the equipment of a modern factory, and one of the largest of its kind.

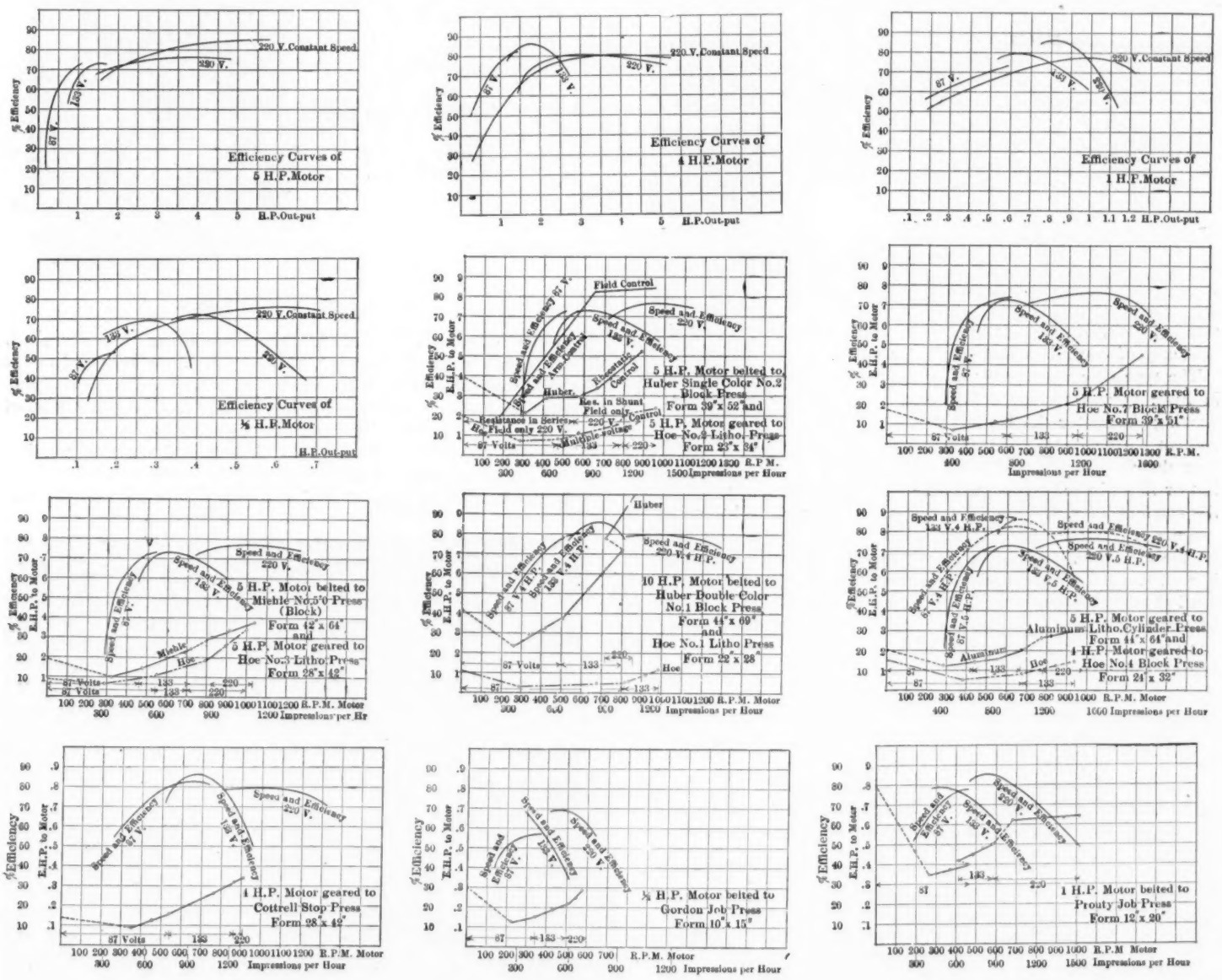
Previous experience with long lines of shafts and cone pulleys and the attendant difficulties in the way of increase in size of plant and speed regulation of the presses pointed the way to individual motor drive in the new factory, irrespective of other conditions.

The several classes of service demanded in the factory for elevators, lighting, ventilation, line shafts, electrotyping and the individual driving of a variety of makes and sizes of presses had all to be considered separately and as a whole in the selection of the generating equipment. Continuous current in sufficient amount could not be obtained from distributing companies, owing to the distance from centers of distribution, though two-phase, 60-cycle, alternating current at 2,200 volts was available at a comparatively low rate.

The particular requirements of speed variation for many of the presses rendered the use of induction motors for individual drive impossible. Continuous current was necessary for elevator service, and after careful consideration of the possibilities and limitations of an isolated, steam-driven generating plant, it was finally decided to purchase alternating current from a distributing company for lighting and line shaft motors and for driving a motor-generator set to furnish continuous current. At the same time the distributing company's 220-volt, three-wire, continuous-current service was run into the building to furnish power for the elevators and a small number of the press motors in case of accident to the motor generator set.

The generating equipment consists of a 150-hp, 2,080-volt, two-phase induction motor, directly connected to and mounted on a common bedplate, with two 50-kw, continuous-current generators, one wound for 87 volts and the other for 133 volts, both being compounded flat.

For the control of the induction motor, generators and feeders, the main switchboard is made in three panels, with bus-bars and switches so arranged as to permit either generator to supply cur-


Efficiency Curves of 5 H.P. Motor
Efficiency Curves of 4 H.P. Motor
Efficiency Curves of 1 H.P. Motor
Efficiency Curves of ½ H.P. Motor
5 H.P. Motor belted to Huber Single Color No. 2 Block Press Form 39"x 52" and 5 H.P. Motor geared to Hoe No. 2 Litho. Press Form 23"x 34"
5 H.P. Motor belted to Huber Single Color No. 2 Block Press Form 39"x 51"
5 H.P. Motor belted to Miehle No. 5'0 Press (Block) Form 42"x 64" and 5 H.P. Motor geared to Hoe No. 3 Litho. Press Form 28"x 42"
10 H.P. Motor belted to Huber Double Color No. 1 Block Press Form 44"x 69" and Hoe No. 1 Litho Press Form 22"x 28"
5 H.P. Motor geared to Aluminum Litho. Cylinder Press Form 44"x 64" and 4 H.P. Motor geared to Hoe No. 4 Block Press Form 24"x 32"
4 H.P. Motor geared to Cottrell Stop Press Form 28"x 42"
½ H.P. Motor belted to Gordon Job Press Form 10"x 15"
1 H.P. Motor belted to Prouty Job Press Form 12"x 20"

FIGS. 1 TO 12.—HORSE-POWER CURVES.

The latter are heavy rubber-covered cables, supported by porcelain cleats along the brick walls of the building and tapped at intervals by the feeders extending between rows of presses. Each set of rent independently to the two outside wires of the three-wire distributing system or the normal operation of the two generators in series. Double-throw switches are provided for connecting the feeders to the distributing company's continuous-current service, so that in case of accident current at 110 or 220 volts is available.

Four separate classes of service are supplied from the feeder panel, as follows: 220-volt continuous current to the elevator motors on a two-wire system; 220-volt, two-phase, alternating current on four-wire system to induction motors driving line shafts in the cutting, transfer, varnish, binding and electrotyping departments; 110-volt, two-phase, alternating current for lighting, and the continuous-current, three-wire mains from the motor-generator set to press motors.

feeders is brought down the wall into a cabinet, in which is installed a three-pole switch and cut-out, and in leaving the cabinet is led through iron conduit into a sewer-tile duct, laid beneath the concrete floor of the building. Junction boxes are provided at intervals, and from these radiate lateral branches to the press motors and controllers.

With the arrangement of generators and switchboard described, a pressure of 87, 133 or 220 volts is available at the motor terminals, and for presses requiring wide variations of speed, regulation is effected by means of multiple-voltage control, with a special form of controller. On the other hand, where the nature of work done on a press is nearly uniform and no necessity arises for a great range of speed, regulation is effected by rheostatic control only, and the motor is operated on the two outside wires of the system at 220 volts, the ratio of gears or pulleys being adjusted for the normal

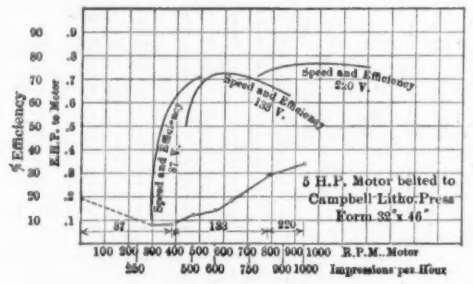

% Efficiency
H.P. to Motor
Speed and Efficiency 220 V.
Speed and Efficiency 133 V.
Speed and Efficiency 87 V.
5 H.P. Motor belted to Campbell Litho. Press Form 32"x 46"
87
133
220
100 200 300 400 500 600 700 800 900 1000 R.P.M. Motor
250 500 600 750 900 1000 Impressions per Hour

FIG. 13.—HORSE-POWER CURVES.

running speed of the press in such a manner as to insure a maximum efficiency of control at that particular speed.

The type of controller used for multiple-voltage control is shown in Figs. 15 and 16, and is operated in the following manner: In starting the motor the field switch, *A*, is closed, providing exciting current to the motor field at 220 volts and also to the magnet, *M*. The double-pole, double-throw main switch, *D*, is then closed to left or right, in accordance with the desired direction of rotation, and the starting lever, *L*, brought up to its position and held there by the magnet, when the motor starts at its slowest speed with 87 volts on the armature. To obtain higher speeds, the controlling lever, *C*, is moved to the right and introduces resistance in the shunt field until the lever engages with the spring switch, *S*, which is thrown into the opposite position by the forward motion of the lever, giving 133 volts on the armature and full field strength. Increase in speed is again obtained by a forward motion of the lever, weakening the field as before until the lever operates the second spring switch, *T*, when the motor runs on 220 volts with full field strength. A further movement of the lever brings the motor up to full speed by gradually weakening the field.

To obtain lower speeds it is only necessary to reverse the operation of the controlling lever and the motor may be stopped irrespective of its position by pressing the push button, *B*, which short-

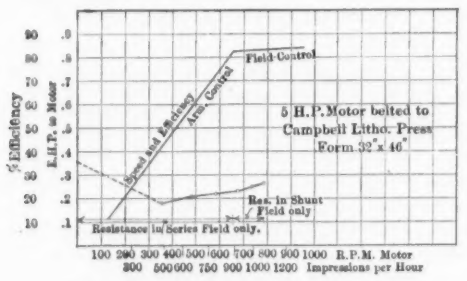

% Efficiency
H.P. to Motor
Field Control
Speed and Efficiency Arm. Control
5 H.P. Motor belted to Campbell Litho. Press Form 32"x 46"
Res. in Shunt Field only
Resistance in Series Field only.
100 200 300 400 500 600 700 800 900 1000 R.P.M. Motor
300 500 600 750 900 1000 1200 Impressions per Hour

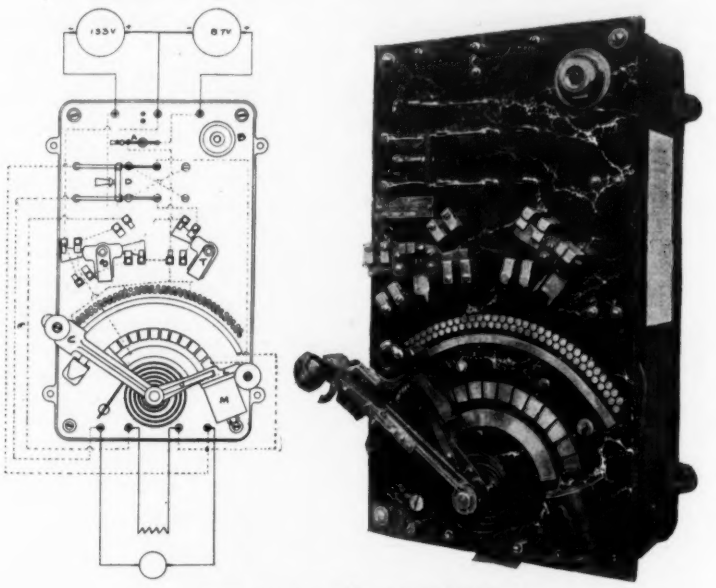
FIG. 14.—HORSE-POWER CURVES.

circuits the magnet and allows the starting lever, actuated by its spring, to swing back to the "off" position, carrying the controlling lever with it. Other push buttons are, in some cases, arranged at convenient places on the press to effect the same result.

The controllers are mounted on oak panels, supported by iron framework from the floor and press, conveniently located to the hand of the operator. On the back of each panel is mounted a three-pole switch for cutting out the controller for change or repair.

For straight rheostatic control on 220 volts, the controllers installed are known as the "R-43" of General Electric Company's manufacture, and are similar in appearance to the ordinary street car controller. Altogether, this form of controller has twelve points, ten speed points forward and reverse, one brake point and one "off" point. For the brake point an auxiliary resistance is provided, through which the armature is short-circuited, and the press brought to a quick stop.

The first four speed steps are obtained by cutting out resistance



FIGS. 15 AND 16.—CONTROLLER.

from the series field circuit, the shunt field being fully energized. These steps are used in starting, backing up, or making ready. On the fifth step there is no resistance in either field and the remaining speeds are obtained by weakening the shunt field. The range covered by the last six steps is from about two-thirds to full speed.

The main cylinder of the controller is arranged to act as a safety device in case of overload or "no voltage," by means of a spring normally latched. The magnet serving to strip the latch may be con-

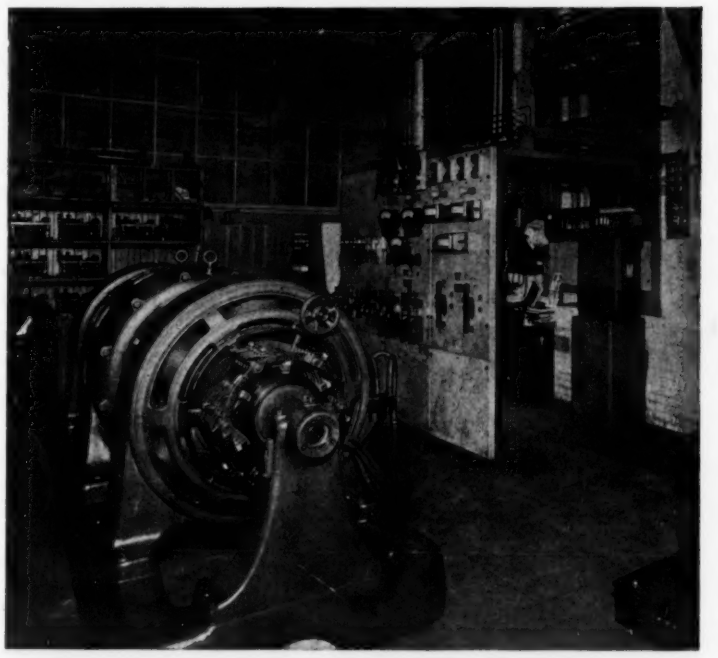


FIG. 17.—MOTOR-GENERATOR SET AND SWITCHBOARD.

nected to push buttons placed in convenient positions on the press. An adjustment is provided with the resistance through which the armature is short-circuited on the brake point, so that the brake may be arranged to stop the press in any desired position.

It has been found that the overload release may be so delicately adjusted that failure on the part of the operator to keep the press oiled and in proper condition is at once detected by stoppage of the motor, and while this may appear to be of slight importance, experience has clearly shown no little loss of power and wear due to such neglect.

In the block or type press, lithographic press and job press depart

ments of the Mutual Label & Lithographic Company there are now installed over sixty motors, ranging in size from ½ to 10 hp, and driving presses of more than twenty different sizes and makes. The greater number of these motors are shunt-wound and operated on the multiple-voltage system, while all the motors on straight rheostatic control are compound-wound. A distinct advantage gained by the use of multiple-voltage control lies in the fact that on account of the low motor speeds at fair efficiencies obtained with standard motors on this system, the first cost of special slow-speed motors is eliminated, and the ratio of gearing or pulleys is kept within reasonable limits.

Little difficulty is experienced with modern presses in adapting the individual motor drive, since this has become the rule rather than the exception, and manufacturers have come to a recognition of the limitations of standard motor speeds. The adaptation of motor drive to presses originally built to be driven from line shafts with cone pulleys, is, in most instances, quite a different matter, and a combination of both cases in the same plant could hardly be solved satisfactorily without a rather flexible system of speed control.

Economy of floor space, usually an important factor in determining the connection between motor and press, is most readily attained through gearing. An overhead belt drive is always to be avoided in press work, on account of dust and obstruction to light and head room, while motors located on the press floor must be out of the operator's way and yet easily accessible for proper attention. This results in very short belt drives in cases where the use of gears is not advisable for mechanical reasons.

At the Mutual Label & Lithograph Company's factory only the rotary aluminum presses and a few of the lighter reciprocating presses are geared to their driving motors. All the others are connected by comparatively short belt drives, and a few are arranged with tightening pulleys. Experience in the factory has shown that the element of flexibility in a belt drive in printing shops is necessary with presses of the heavier type, in which the beds have a reciprocating motion. In one or two instances the press actually drives the motor during a part of the movement of the press bed, and it may readily be understood that the effect of this with gearing is not only injurious to the gears themselves, but to the press and motor as well.

The life of cut gears and rawhide pinions in the factory has been

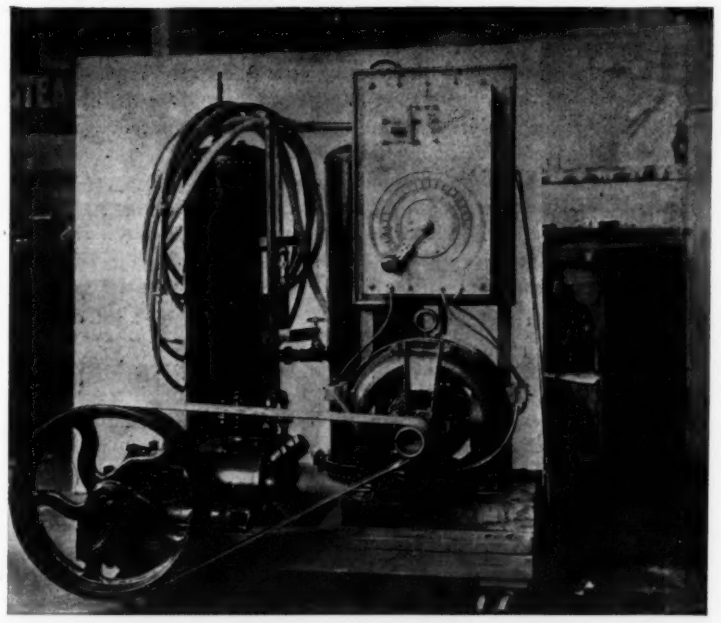


FIG. 18.—PORTABLE AIR COMPRESSOR AND MOTOR.

found to be approximately the same as the life of belts for the same class of work.

In Figs. 1, 2, 3 and 4 are shown the efficiency curves of four motors when run at constant speed on 220 volts under different loads and when run at various speeds and loads on the multiple-voltage system. These curves show a decided gain in efficiency for the multiple-voltage system at small outputs, and, therefore, at slow speeds, since the power required to drive presses is nearly directly proportional to the speed. If the extreme limits of speed variation were obtained by the use of rheostatic control on 220 volts, the gain would be still more apparent. At higher outputs and speeds a loss of efficiency is shown, due to the insertion of resistance in the shunt field of the motor.

The curves shown in Figs. 5 to 14, inclusive, represent the electrical horse-power taken by motors of different sizes driving presses of various makes and sizes over the range of speed used in actual operation. The power curves are plotted with speed of motor as abscissæ and electrical horse-power input as ordinates. The range of the different voltages and the impressions per hour made by the press are shown in relation to the speed of the motor. The efficiency curves are plotted with speed as abscissæ and per cent. efficiency as ordinates. Where rheostatic control is used alone, it is indicated by the notation.

In Fig. 5 is shown the power curve of a 5-hp motor driving a Hoe No. 2 lithographic press. It will be noticed that in this case changes

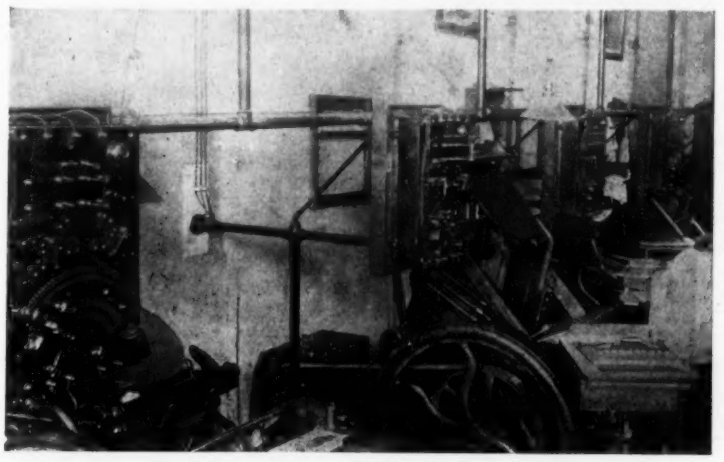


FIG. 19.—PORTION OF JOB PRESS DEPARTMENT, SHOWING ARRANGEMENT OF CONTROLLERS AND ½-HP MOTOR DRIVING JOB PRESS.

of voltage are made by the controller at very nearly the correct points for maintaining the best efficiency, while in Fig. 6 it is evident that for the same size of motor and controller the change from 133 to 220 volts should occur at about 700 r.p.m. instead of 945 r.p.m. With a knowledge of existing conditions, as shown by the various curves, it becomes possible to so adjust the controller resistance for each press as to attain the best efficiencies throughout the range of speed desired. In some instances controller contacts on 133 volts have been connected so that it becomes necessary to step over to 220 volts, in order to run at the normal speeds of the press, thus forcing the press operator to obtain on 220 volts the speed which he was accustomed to use on 133 volts, and thereby gaining a higher efficiency and a better division of the load between the two generators.

Figs. 13 and 14 show the power curves of motors of the same rated horse-power driving presses exactly alike in every respect, the one with multiple voltage and the other with rheostatic control. The ratio between revolutions per minute of motor and impressions per hour of the press is slightly greater in the latter than in the former case. A comparison of the two curves shows in a general way the difference in rheostatic and multiple-voltage control at slow speeds without taking into account the relative efficiencies of the two motors and conditions of the press bearings, etc.

During three years' operation, the installation has proven satisfactory in every respect. As was expected, the repairs to multiple-voltage controllers have constituted almost the only item in the repair account of the electrical department.

Dust from the bronzing machines has in several instances caused short-circuits between commutator connectors, but this trouble has been largely eliminated by the frequent use of a small, portable, motor-driven air-compressor for blowing the dust out of motors and presses.

Daily reports of time and material used in repairs and in oiling and cleaning motors in each department are carefully kept, forming a history of every part of the electrical apparatus.

The necessity for speed variation in label and lithographic work is due primarily to difference in the class of output from the same press and in efficiency of operators.

In the block or type press and lithographic press departments, the necessary range of speed for different classes of work, with few exceptions, can be obtained on the running points of the rheostatic control before described, with a proper adjustment of gear or pulley ratios. The same is not true, however, for the job press department, where the variety of work, and hence the range of speed desired, is far greater. In the latter department the presses are fairly small, and, therefore, the losses with rheostatic control at low speeds would be comparatively slight.

In "making up" a press low speeds are always required, with frequent starts and stops, and after "make up," from the operator's point of view, it is a very decided advantage to be able to attain the running speed desired, by slight increments, while making the finer adjustments of the consistency of the ink to the quality of work and paper.

The frequent "breaking in" of new pressfeeders requires speeds low at first and increasing with the efficiency of the operator. With multiple-voltage control, this condition is readily met, while with rheostatic control it is necessary to run the press at inefficient speeds,

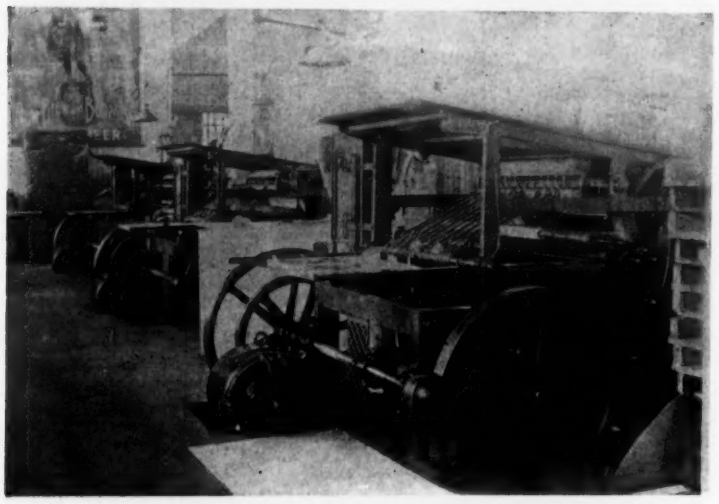


FIG. 20.—MOTORS GEARED TO HOE PRESSES.

or to so arrange the ratio of gears or pulleys that the press can never be worked at a speed corresponding to its maximum output.

Of the accompanying illustrations, Fig. 17 shows the motor-generator set and switchboard; Fig. 18 a portable air compressor and motor; Fig. 19 a view of the job press department, showing arrangement of controllers and a ½-hp motor driving a job press; Fig. 20

FIG. 21.—CAMPBELL LITHOGRAPHIC PRESSES.

a 5-hp motor geared to a Hoe press, and Fig. 21 a belted Campbell lithographic press.

The entire electric equipment of the factory was planned by the Engineering Offices, of San Francisco (now Cory, Meredith & Allen), and installed under their supervision. It has since been in charge of Mr. Alfred Peterson, who assisted in making tests of the motors, and to whom much credit is due for the efficient operation of the plant. The writer wishes to acknowledge the courtesy of the Mutual Label & Lithographic Company in providing every facility for making the tests.

Wireless Fire Alarms.

A Washington dispatch to one of the New York newspapers states that Secretary of Agriculture Wilson has decided to install a wireless telegraph system of fire alarms in all Government forest reserves throughout the country. Mr. Wilson thinks that this will contribute greatly to their preservation from destruction by fire.

Two Methods of Locating Faults in Telephone Cables.

BY H. B. STABLER.

THE two methods which it is the purpose of this article to describe have been proposed, and at least one of them put to practical and successful use by Mr. F. T. Iddings, of Washington, D. C. They were designed to meet the requirements of certain cases in which the tests ordinarily used for determining the location of grounds or leaks on cable conductors cannot be applied.

Before proceeding to discuss these methods, it may be well to describe very briefly the usual galvanometer and bridge method of locating grounds.

When, owing to electrolysis or other cause, water finds its way through the lead sheath of a paper-insulated cable, prompt action by the maintenance department of the telephone company in discovering and reporting the trouble, and a quick response by the cable department, can, in most instances, secure the location of the trouble before all of the conductors have been reached by the moisture. Either of the well-known Murray or Varley loop tests is used for this—preferably the Murray test, as it is simpler and gives very satisfactory results. If the cable conductors are of the same gauge throughout their entire length, and this length is known, it is not necessary to know their resistance. Thus, in the following diagram showing the application of the Murray loop test to a defective cable,

FIG. 1.—MURRAY LOOP TEST.

$M\,N$, let $a\,b$ and $c\,d$ represent, respectively, a good conductor and a conductor which is more or less grounded at e. With $a\,b$ and $c\,d$ connected together at one end of the cable, and a galvanometer, G, and a ratio arm, A, and an adjustable arm, B, of a Wheatstone bridge connected, as shown, at the other end, the distance, $c\,e$, is given directly in feet, when a balance has been obtained, by the familiar equation, $\frac{A+B}{B} = \frac{R+X}{X}$, A and B being, of course, in ohms, and R and X being in feet; R consisting of the sum of the two distances, $a\,b$ and $d\,e$, X consisting of the distance, $c\,e$, and $R + X$ being, therefore, twice the length of the cable in feet. With suitable instruments this method will give an accurate determination of the location of the trouble even though the ground on the defective conductor is a very imperfect one, and has a resistance many times as great as the resistance of $a\,b$ and $c\,d$.

Cases sometimes occur in which all of the conductors in a cable have become defective, but while some are quite heavily grounded there are others on which the ground or "leak" is very slight. In such cases the Murray loop test may still be applied with fair success, provided there is no disturbing difference of potential between the two wires selected for the test. Thus, in Fig. 1, if $a\,b$ and $c\,d$ be two conductors of such length and gauge as to have each a resistance of say 100 ohms, and $c\,d$ is grounded at e through 100 ohms resistance, and $a\,b$ is grounded at the same point through a resistance of 100,000 ohms, a loop test can be applied without being subject to any considerable error through the lack of perfect insulation of $a\,b$.

Again, I have known cases where the conductors in a cable had all become either comparatively heavily grounded, or approximately equally grounded, so as to preclude the application of a loop test between any two of its wires, but in which the Murray loop test had still been successfully applied by having recourse to an aerial wire or to a conductor in another cable. Thus in Fig. 1, if we conceive $a\,b$ to represent, instead of a wire in the faulty cable, $M\,N$, a well-insulated aerial wire, or a conductor in some other cable or cables by which the point N can be reached from the point M, the test can be made in the usual way. It is not necessary to know the length or resistance of either $a\,b$ or $c\,d$; a single preliminary measurement with the bridge of the resistance of the loop will give the sum of these resistances $R + X$, and X, or $c\,e$, being obtained, in this case, in ohms, may be readily reduced to feet.

Of course, all telephone men know to their sorrow that cables will sometimes "go to the bad" without warning, and under such conditions that there is no possible way of applying the ordinary loop tests. The simple test outlined below has been successfully used

for locating such faults on lead-sheathed aerial cable as these.

The test depends upon the fact that the sheaths of aerial cables are often comparatively well insulated from the ground; or if heavily grounded the ground is usually at some certain point or points. In Fig. 2 let *M N* represent an aerial cable whose sheath and supporting wire being in contact only with the dry wood of cable boxes, poles and cross arms, are normally insulated from the ground throughout their length. Let *a b* represent a conductor, or conductors, which

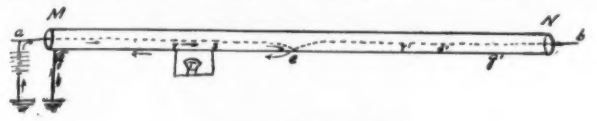


FIG. 2.—CABLE TEST.

are in electrical contact with the sheath at the point *e*. By artificially connecting the sheath to ground at *g*, and connecting a battery as shown at *a*, a current can be made to pass through the conductors from *a* to *e*, and through the sheath from *e* to *g*. By applying the terminals of a sensitive galvanometer such as a millivoltmeter, to two points, *r* and *s*, a few feet apart on the sheath of the cable between *g* and *e*, the presence and direction of this current will be indicated by a deflection of the needle. By repeating the test at other points on the cable, the point *e*, where the current first reaches the sheath from the conductors, can obviously be located, since between any two points, *r'* and *s'*, situated beyond the point *e*, there will be no current flowing, and therefore no difference of potential and no deflection of the galvanometer. If the cable sheath should be already grounded at two or more points, the test is still applicable. It is clear from the figure that with grounds at both *g* and *g'* the point *e* can be exactly located, not by the absence of deflections at points beyond *e*, but by deflections at points between *e* and *g'* in the opposite direction to those obtained at points between *g* and *e*, as any current passing from the conductors to the sheath at *e* will evidently divide and a part of it flow in each direction from *e* to the ground.

Of course, this method fails in cases where there is a high resistance in the cross between the conductors and the sheath, as in such cases it is impracticable to get a large enough current through the circuit to give the desired deflections. The amount of current required is, however, not very great. For instance, with a cable sheath whose resistance is 0.1 ohm per 1,000 ft., or about the same as No. 0 B. & S. gauge copper wire, the difference of potential between two points on its surface 4 ft. apart will be 0.1 millivolt if it is carrying a current of 0.25 amp. In a central energy telephone system such a current may often be fed from the central office through cable conductors to the desired point, in order to save the party engaged in making the test the trouble of transporting a suitable battery to the end of the aerial cable. Indeed, it is probable that, in some cases, enough current to make the test may be found to be already supplied to the cable sheath from central energy subscribers' lines within the cable.

The foregoing method would also evidently fail where the cable sheath was grounded at points each side of *e*, and there were already differences of potential, due to foreign causes, between these points.

For the underground cable of a central energy system it is proposed, when all conductors have become impaired, to use a simple test, dependent upon the fact that in such cases there can usually be found idle conductors in the cable between which there is a small but appreciable difference of potential. Since one conductor of each working pair connects with the + pole of the central office battery, and the other conductor with the — pole, the above-mentioned condition is almost certain to exist; that is, there will be some conductors which, at the point where the insulation is moistened or soaked, will be in better electrical connection with the + working conductors than with the —, and some others that will be in better connection with the — than with the +. The proposed test, as originally conceived, consisted in taking, on two such conductors, simultaneous current readings with milliammeters at the two ends of the cable, and deducing from these the ratio of the two resistances, and therefore of the two distances, from the ends of the cable to the fault; the fault being regarded as a source of e.m.f. which causes current to flow through the two branches of the circuit in parallel. The millivoltmeter being an instrument in much more common use than the milliammeter, the substitution of it for the latter at once suggests itself as the first step toward simplifying the method and bringing it more within the reach of the practical cable tester. In Fig. 3 suppose *a b* and *c d* to be two conductors in the cable, *M N*, defective at *e*, and *V* and *V'* two millivoltmeters of known resistances, *r* and *r'*, and connected as shown. Let *C* and *C'* be, respectively, the currents flowing through the two branches of the circuit, due to a difference of potential, *E*, between the conductors at *e*; *D* and *D'* the deflections, in volts, of the two instruments, and *R* and *R'* the resistances of the cable conductors in the two branches; that is, *R* = the sum of the resistances of *a e* and *c e*, and *R'* = the sum of the resistances of *e b* and *e d*. *C* and *C'* are obtained at once as the quotients of $\frac{D}{r}$ and $\frac{D'}{r'}$, and since $C = \frac{E}{R + r}$ and $C' = \frac{E}{R' + r'}$, we have, by eliminating *E*:

$$\frac{C}{C'} = \frac{R' + r'}{R + r}. \qquad (1)$$

The method presupposes that the length and gauge, and, therefore, the resistance of the conductors, is known. So by putting the equation in the form

$$\frac{C + C'}{C'} = \frac{R' + r' + R + r}{R + r}, \qquad (2)$$

or

$$R = \frac{C'\,(R + R' + r + r')}{C + C'} - r, \qquad (3)$$

we very readily obtain a numerical value for *R*, since *C*, *C'*, *r* and *r'* are all known quantities, and $(R + R')$ is also known, being the total resistance of the pair of conductors. It only remains to reduce the numerical quantity, *R*, from ohms to feet, and one-half of the result will be the required distance, *a e*, from the end of the cable at *M* to the fault.

It is believed that in most instances this method can be modified so as to require the use of but one millivoltmeter—a simplification that will undoubtedly add considerably to the practical value of the method. Since usually the current which passes from the surrounding conductors, *p* and *q*, to the conductors, *a b* and *c d*, encounters in the impaired insulation at *e* a resistance which is very high as compared with the resistances of the conductors themselves, the total resistance of the circuit from the point *p* to the point *q* will be ap-

FIG. 3.—DIAGRAM OF CONNECTIONS.

proximately the same no matter whether the circuit be closed through both branches from the point *e* or through only the one branch, consisting of the parts *e a*, *V* and *c e*, the resistance of which is $R + r$. It follows, then, that if two readings be taken of the deflections of the needle of *V*, one while the opposite branch, *R'*, of the circuit is open at *b* and *d*, and the other while it is closed by short-circuiting the two points, *b* and *d*, the current, *C''*, which flows through the single circuit, $R + r$, in the first instance, will be approximately equal to the sum of the two currents which, in the second instance, pass through the two parallel circuits, $(R + r)$ and *R'*. Calling these currents, as before, *C* and *C'*, it is plain that *C'* can be obtained by subtracting *C* from *C''*, and that the value of *R* will be given by

$$R = \frac{C'\,(R + R' + r)}{C + C'} - r, \qquad (4)$$

which is the same as equation (3), except for the fact that it does not contain the quantity *r'*.

If in the application of this method it is not possible, with the instruments at hand, to obtain deflections great enough to be read with a fair degree of accuracy, the test evidently fails. If, on the other hand, the difference of potential between the conductors under test is so great as to give more than a full scale deflection of the millivoltmeter, the difficulty can be overcome by shunting the meter with a suitable known resistance. If *C* is the total current in amperes passing through the meter and the shunt, *R* the joint resistance of the meter and the shunt, and *D* the deflection in volts, $C = \frac{D}{R}$, and

$R' = \frac{m\,s}{m+s}$, where m is the resistance of the meter and s that of the shunt.

In conclusion, I would remark that the application of this method could probably be extended so as to include cables other than those of a central energy telephone system; that is, cables not already containing any "live" wires—by simply temporarily connecting some of the conductors at one end of the cable to the two poles of a suitable battery or other source of e.m.f. in order to produce artificially the conditions existing in cables of a central energy system.

A Physical Conception of Some Alternating-Current Phenomena—I.

BY LAMAR LYNDON.

ALTERNATING-CURRENT phenomena have been fully investigated, and the results given to the technical public, but it appears that the able mathematicians who have developed the various theories have been content to express these phenomena by algebraic equations, which do not indicate, to the average engineer or student, the actual physical happenings which take place.

It is the object of this article to consider briefly the subjects of resistance, inductance and condensance in alternating-current circuits, and to show, physically, their relationships. The physical nature of the phenomena being clearly understood, it is easy to put them into quantitative form, even by those of limited mathematical training.

It is customary in discussing alternating currents to speak of the current as "lagging" behind or "leading" ahead of the e.m.f., and the student believes that somehow the current actually follows or precedes the e.m.f., *which causes it to flow* when inductance and condensance are present—which is in nowise true.

Also, it is usual to state that when inductance or condensance is present in a circuit, an alternating current does not flow through it in accordance with Ohm's law—which is also untrue.

It is assumed that the reader understands how alternating e.m.f's and currents rise, fall and reverse in accordance (theoretically) with the sine law; what "phase" is, and has the general preliminary knowledge of the subject.

When an alternating e.m.f. is impressed on a circuit in which there is only resistance, the current will flow exactly in phase with, and in a quantitty proportional at each instant, to the e.m.f. Fig. 1

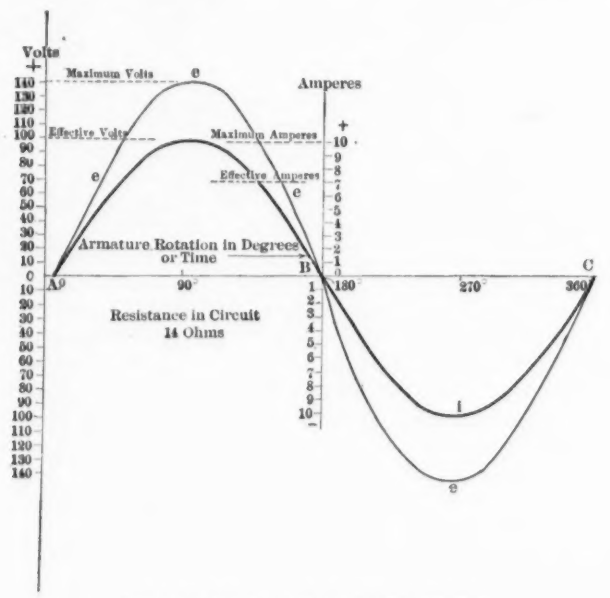


FIG. I.—E.M.F. AND CURRENT CURVES.

shows this condition; e, e, e, e is the impressed e.m.f. and i, i, i, i is the curve of current flow.

As may be seen, the current flow is exactly in phase with the e.m.f. and at any instant is equal to the e.m.f. at that instant divided by the resistance.

INDUCTANCE.

If an inductance be inserted in the circuit the current flow will be reduced and the *impressed* e.m.f. at any instant, divided by the resistance, will not give the current at that instant.

Consider an inductive coil, as shown in Fig. 2. If current pass through the coil, magnetic lines are set up threading the turns as shown. If the current should vary in intensity or direction, the number or direction of the lines of force will also change; this change

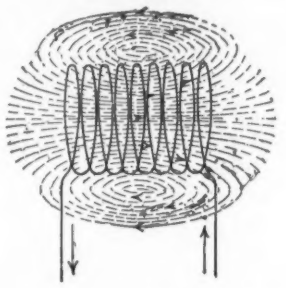


FIG. 2.—LINES IN INDUCTIVE COIL.

in the magnetic lines taking place exactly with the current variation. Any change in the number or direction of the lines of force threading a coil will produce an e.m.f. in the coil, just as the change in the number of lines of force through an armature coil produces an e.m.f. Also, the more rapid the change in current through the coil, the more rapid is the change in magnetization, and, therefore, the greater is the e.m.f. set up in the coil. The e.m.f. produced by the change in current is always in such a direction as to oppose this current change, and, therefore, when the current tends to decrease, assists it to continue flowing and opposes the current flow when it begins to increase.

If in Fig. 3 the curve i, i, i, i is drawn to represent the magnitude and direction of the alternating current to any arbitrary scale, the

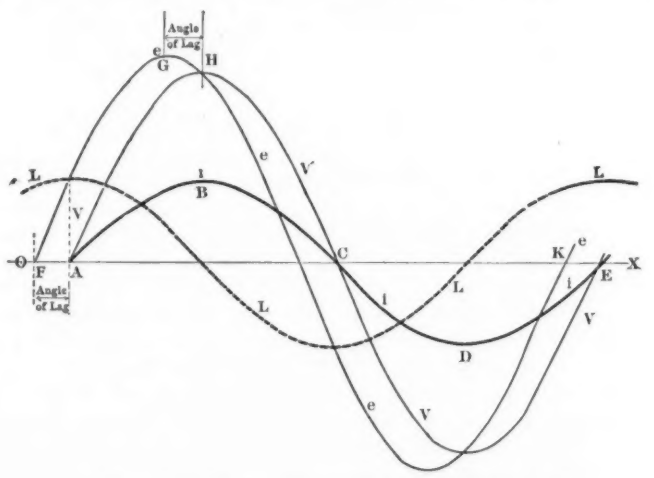


FIG. 3.—EFFECTS OF INDUCTANCE AND RESISTANCE.

ordinates being amperes and the abscissæ units of time—say, hundredths of a second—the ordinate at any time will show the value of the current at that instant.

Assume that both a resistance and inductance are included in the circuit. The changes in the value of the current through the inductance coil will produce in that coil an e.m.f. When the current is not changing—which condition exists when the crest of the wave is reached, as at B and D—the lines of force in the coil do not change and consequently the inductance e.m.f. is zero. The current changes most rapidly when it is passing through zero—that is, when crossing the zero line from + to —, or — to +, and the lines of force also changing most rapidly at this time, the inductance e.m.f. is greatest.

The curve L, L, L, L is the inductance e.m.f. and plotted so that it is zero at the time the current is maximum, and maximum when the current is zero. The distance from A to E represents a complete cycle, or if referred to the armature which produces the current flow, one complete revolution (bi-polar machine) of the armature. This being 360°, and the inductance e.m.f. being ¼ the distance from A to E behind the current, it is conveniently referred to as being 90° behind the current, i. e., as the armature rotates it passes through ¼ revolution, or 90°, after the current begins to start from zero, before the e.m.f. of inductance begins to rise in the opposite direction.

Since the current passes through a resistance, the e.m.f. which causes it to flow is equal at any instant to the value of the current

at that instant multiplied by the resistance. The curve V, V, V, V represents this e.m.f., which is in exact phase with the current. The impressed e.m.f. to cause the current flow must be equal to the e.m.f. V, V, V, V, plus an additional amount equal to the e.m.f. of the inductance at those times when the current is increasing, and less than V, V, V, V, at those times when the current is diminishing, because the e.m.f. of the inductance opposes change of current strength. By adding to the ordinates of V, V, V, V the corresponding ordinates of L, L, L, L, above the line O, X, and subtracting from V, V, V, V the corresponding ordinates of L, L, L, L, below the line O, X, where $V, V\ V, V$ is still above the line—in other words, taking the algebraic sum of the ordinates of the two curves—the curve e, e, e, e results, which shows the value and phase of the e.m.f., which the alternator must deliver to the line in order to send the current i, i, i, i through the resistance of the circuit and overcome the opposing inductance e.m.f. The presence, then, of an inductance in the circuit adds an e.m.f. to the system, and the useful or active e.m.f. which sends current through the circuit is the *resultant* of the e.m.f's acting: The current is always in exact phase with the resultant e.m.f., and is at any instant equal to the resultant e.m.f. at that instant, divided by the resistance of the circuit.

Since e.m.f's may be combined like other forces and the inductance e.m.f. is at 90° to the resultant e.m.f., it is convenient to make computations graphically as in Fig. 4. If $I\,R$ represents the effective

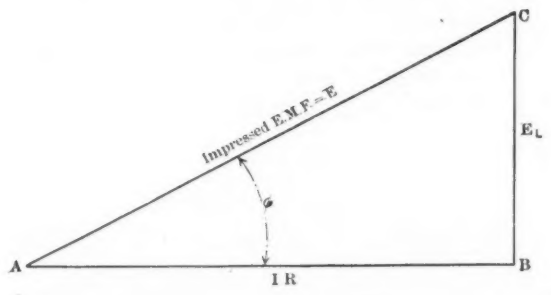


FIG. 4.—E.M.F. DIAGRAM.

value of the resultant e.m.f., and E_L that of the inductance, and they be laid out to proper scale at 90° to each other as shown, the line $A\,C$ will be the effective value of the impressed e.m.f. The angle ϕ is called the angle of lag, and shows that the armature of the alternator supplying the impressed e.m.f. turns through an angle equal to ϕ from the position where its e.m.f. is zero, before the current begins to rise from zero. This is shown by Fig. 3. If $F\,K$ represent the time of a complete revolution of the alternator armature, the impressed e.m.f. begins to rise from zero at F; but it passes through the time—or distance—from F to A before the current begins to rise, for the reason that not until A is reached is the alternator e.m.f. equal to the opposing e.m.f. of the inductance. $F\,A$, then, is the angle of lag, and equal to ϕ in diagram 4. If $F\,K$ be called 360°, $F\,A$ is the number of degrees of the angle of lag to the same scale. $G\,H$ shows also the angle of lag, being the difference in time or degrees in which the impressed e.m.f. and current reach their respective maxima.

From Fig. 4 it is also evident that the impressed e.m.f. $= E =$

$$\sqrt{(I\,R)^2 + E_L^2} \qquad (1)$$

In Fig. 3 it will be found that at any instant the value of the impressed e.m.f. is equal to the square root of the sum of the resultant e.m.f. squared and the inductance e.m.f. squared, if it be remembered that the value of the inductance e.m.f. becomes negative when on the opposite side of the line $O\,X$, from the resultant e.m.f.

The triangular diagram shown in Fig. 4 is merely a convenient method of calculating the relations between the various quantities and must not be confused with the actual effects which are taking place in the circuit. Also the use of the term "angle of lag" does not mean that the current lags behind the e.m.f. which causes it to flow. It lags behind the impressed e.m.f. and is ahead of the inductance e.m.f., but actually in phase with the resultant e.m.f.

The value of the inductive e.m.f. is found as follows:

The unit of inductance is called the henry and is equal to that inductance which will produce a volt when the current through the coil changes at the rate of one ampere per second. Since the voltage will vary directly as the rapidity of cutting of lines, and, therefore, with the rapidity of change of current, a coil of one henry inductance $= L$, would give 50 volts if the current should vary one ampere in 1/50 second, or would give 100 volts if the current should change two amperes in 1/50 second.

When an effective current of one ampere, which follows the sine law, passes through one cycle per second, the rate of current change is 2π, or 6.28 amp. per second, from which it follows that the effective e.m.f. set up at the terminals of the inductance is

$$2\pi \times f \times I \times L \qquad (2)$$

in which

f = number of cycles per second,
I = current in effective amperes,
L = coefficient of self-induction in henrys.

This coefficient 6.28 may be also arrived at in another way.

If a conductor is rotated in a magnetic field, it will cut all the lines of force twice in a complete rotation, and a loop or single turn —which is two conductors—will cut all the lines four times.

The *average* voltage, therefore, of a rotating loop is $\frac{4 \times f \times N}{10^8}$,

where f = frequency or number of rotations per second and N = total number of lines in the magnetic field.

An alternating current or e.m.f. varies in value with the sine of the angle through which the loop rotates, reckoned from any fixed point in the circle in which it travels, and the *average* value of the sine through a half cycle is 0.6366 of the value of the maximum ordinate when the crest of the wave is reached.

The *effective* current or e.m.f. is not the average, but is the square root of the mean square of the various values throughout the cycle, and this is equal to 0.707 of the maximum. The effective voltage, then, for a sinusoidal alternating e.m.f., no matter how produced, is

$$\frac{4 \times .707}{.6366} \times \frac{f \times n \times N}{10^8} = \frac{4.44\ f\,n\,N}{10^8} \qquad (3)$$

n being the number of turns in the loop.

The maximum value of the e.m.f. is 1.415 times the effective value, and, in the case of an inductance, the voltage is produced by the change of current from zero to its maximum. Therefore, the voltage self-induced in a coil by a sinusoidally-varying current is

$$E = \frac{4.44\ f\ N\,n\ I\ max}{10^8} \qquad (4)$$

where $I\ max$ is the maximum value of the current.

Since an inductance of one henry produces one volt for one ampere change in current through it in one second, and a volt results from cutting 10^8 lines per second, it is evident that if a coil of one turn has 10^8 lines produced in it by one ampere flowing through it, it has an inductance of one henry. If the coil has 10 turns and 10^7 lines are produced in it by one ampere, then the inductance is also one henry. From which it follows that the inductance of a coil in henries, may be expressed as the product of the number of turns multiplied by the number of lines produced by one ampere, divided by 10^8 or

$$L = \frac{n\,N}{10^8} \qquad (5)$$

Substituting this value for L in equation (4), it becomes:

$$E = 4.44\ f\ L\ I\ max \qquad (6)$$

$$I\ max = 1.415 \times I\ effective.$$

If, now, the *effective* value of I be substituted,

$$E = 1.415 \times 4.44 \times f\ L\ I = 6.28\ f\ L\ I.$$

The coefficient of self-induction (L) is usually determined experimentally.

Referring again to Fig. 4, it is obvious that the tangent of the angle of lag, ϕ, is equal to $\frac{E_L}{I\,R}$. $E_L = 2\pi\ f\ I\ L$, whence tangent of the angle =

$$\frac{2\pi f L I}{R I} = \frac{2\pi f L}{R} = \frac{\omega L}{R} \qquad (7)$$

where $\omega = 2\pi f$.

It is now easy to compute the angle of lag and current flow for any circuit. If the resistance be 20 ohms, $L = 0.5$ henrys, frequency = 60 cycles and impressed e.m.f. = 100 volts, what current will flow?

Volts of resistance for 1 amp. flow = 20.
" inductance " 1 " " $= 0.5 \times 6.28 \times 60 = 18.84$.

Volts impressed per ampere of flow $\sqrt{(20)^2 + (18.84)^2} = 27.5$.

Therefore, $I = \frac{100}{27.5} = 3.64$ amp.

Tangent angle of lag $= \frac{18.84}{20} = .942$, which corresponds to an angle of 43.18 in.

In plotting the curves of alternating currents or e.m.f., it must be remembered that the maximum value at the crest of the wave is 1.415 times the effective value (see Fig. 1).

The quantity $\sqrt{R^2 + (2\pi F L)^2}$ is called the impedance of the circuit and the current flow for a given impressed e.m.f., E, is

$$I = \frac{E}{\sqrt{R^2 + (2\pi F L)^2}} \qquad (8)$$

This formula in no wise shows that the alternating current does not follow Ohm's law, for the impedance is a combination of a resistance and a counter e.m.f.

Deflection of Stator of Direct-Current and Three-Phase Generators.

BY F. NIETHAMMER.

IN the mechanical design of large direct-current and three-phase generators, one of the most interesting and most difficult problems is the evaluation of the vertical deflection of the magnet yoke or of the stator frame, as this deflection cannot be allowed to exceed a certain percentage of the air-gap, say 2 to 10 per cent. Of the same importance is, of course, also the deflection of the shaft, which, however, is easily calculated. If l is the distance between the two bearings of a dynamo, and G is the total load on the shaft concentrated at distances l_1 and l_2 from the two bearings, the deflection, f_s, of the shaft is:

$$f_s = F \frac{a}{d^4} G \frac{l_1^2 l_2^2}{l},$$

where a = coefficient of dilatation

$$\left(\frac{1}{a} = \text{modulus of elasticity} = \sim 2{,}200{,}000\right)$$

d = diameter of the cylindrical shaft, which is taken as constant throughout; all lengths being expressed in centimeters and all weight in kilograms.

For shafts with a longitudinal section resembling a cubic parabola, the expression changes over into

$$f_s = 12 \frac{a}{d^4} G \frac{l_1^2 l_2^2}{l}.$$

The actual deflection is somewhat smaller than this value, as the various forces and loads are not concentrated, but distributed along the hub, which strengthens the shaft.

Calculations of the deflection of dynamo yokes or frames have been given previously by:

(*a*) Linsemann, *Elektrot. Zeitschr.* (Berlin, 1902, p. 81), and mentioned also in ELECTRICAL WORLD, 1903.

(*b*) Schenk, "Festigheits berechnung grosseres Drehstrommaschinen" (a separate treatise). The first author is using the formulas for the curved beam as given in the work of Bach, "Elastizität und Fertigheit," while Schenk builds up his theory on Föppl's mechanics with the formulas of the straight beam. The writers treat the two cases:

(1) The upper half of the yoke or frame is only *loosely* or elastically connected with the lower half (resembling a hinge joint), the frame is split horizontally and the two halves lie loosely on each other; the angle β (Fig. 1) may grow smaller than 90° after deformation;

(2) The two halves are either cast together or are *rigidly* fastened by screws; the angle β must remain 90° even after deformation.

For these two cases and the case in which the frame is replaced by a simple straight beam with the same distance, l, of the supporting points, we get the following results for the vertical deflection, f_f of the frame, supposing that G_f = weight of the whole stator (yoke and poles, or active and inactive part of frame), G_z = excentric magnetic pull, F = useful section of yoke or frame (simple yoke section or frame section without active sheets), Θ = moment of

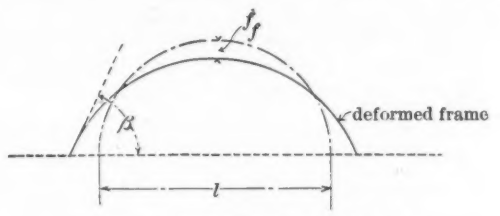


FIG. 1.—DEFLECTION DIAGRAM.

inertia for the same useful section of yoke or frame, $l = 2r$ = distance between points of support or diameter of the circle laid through the center of gravity of the yoke section, a = reciprocal value of the modulus of elasticity (coefficient of dilatation) $\frac{1}{a} =$ ~ 900,000 for cast iron*; $\gamma = \frac{G_f + 2 G_z}{2\pi r F}$:

	Linsemann. Schenk. Straight beam.
Case (1) frame horizontally split and connected loosely or not at all.	$ff = 0.062 F \gamma r^4 \frac{a}{\Theta} = 0.0135 F \gamma r^4 \frac{a}{\Theta} = 0.33 F \gamma r^4 \frac{a}{\Theta}$
Case (2) both halves rigidly fastened or cast together.	$ff = 0.023 F \gamma r^4 \frac{a}{\Theta} = 0.0062 F \gamma r^4 \frac{a}{\Theta} = 0.066 F \gamma r^4 \frac{a}{\Theta}$

There are very marked discrepancies between these results. Writing a general formula, we may put the vertical deflection, ff, in centimeters:

$$f = c \cdot F \gamma r^4 \frac{a}{\Theta} = c \frac{G_f + 2 G_z}{2\pi \Theta} r^3 a,$$

and evaluate c from *thorough tests on actual frames.* Since these are not at hand, one may put

$c = 0.02$ for frames rigidly cast together,
$c = 0.04$ for frames screwed together in the usual way.

These values are very safe and test will probably give lower numbers.

Municipal Telephony in Glasgow.

Mr. J. H. Young, of Glasgow, interviewed in St. Paul, Minn., as to the Glasgow municipal telephone system last week, said: "Public ownership of the telephone, however, is somewhat of a failure. At first the service was very good, but it began to deteriorate and now is very unsatisfactory. The telephone operated by the city covers only points within the city limits. There is a so-called National telephone owned and operated by private capital, through which one may talk with people in London or any other city in Great Britain. Naturally, the National Telephone Company gives the best service." He spoke more favorably of the municipal street car system.

*All dimensions in centimeters and all weights in kilogrammes.

Compensated Motor Railway Equipment of the General Electric Company.

That American engineers were correct in their refusal to adopt the polyphase induction motor for traction purposes was proved beyond any doubt by the successful operation in regular service of a trolley car equipped with single-phase motors on the Ballston division of the Schenectady railway Friday, August 19. Special interest is centered upon the type of motor employed and the comparison of results obtained with direct and alternating-current equipments. Through the liberal policy of the General Electric Company, whose engineers for several years have worked incessantly on the alternating-current traction problem, much valuable information concerning the details of construction and operation of the type of installation adopted has been rendered available for the technical press.

The motor is of the commutator type, possesses the true series characteristics, and it operates equally well with direct or alternating current. In mechanical construction the motor differs from the direct-current machine only as regards the field structure, the armature core, winding and commutator, being essentially equivalent to what is considered best design in direct-current traction motor practice, a four-polar wave winding suitable for operation with two brushes. As applied to the motor in question, the brushes are of standard width and size, and the holders are permanently fixed at the neutral position. The width of air-gap adopted is about twice that employed with stationary induction motors of corresponding

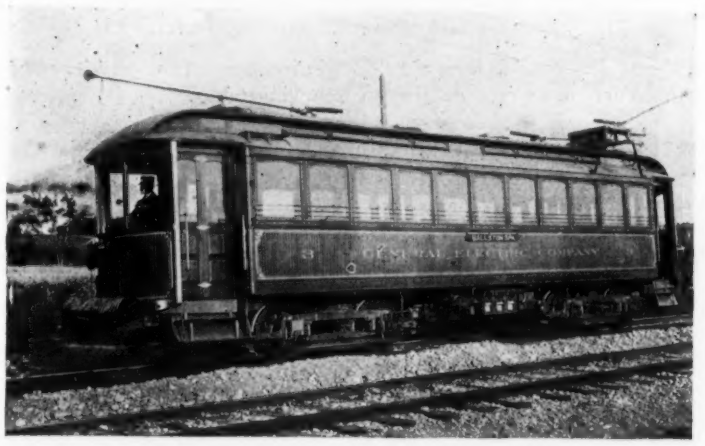


FIG. 1.—ALTERNATING-CURRENT MOTOR CAR.

size. The field core has no projecting poles, but is built up of laminated rings with distributed slots in which are placed windings similar in many respects to those used with two-phase induction motors, one phase winding, however, containing several times as many turns as the other.

The machine belongs to that class designated as "compensated series" motors. This term, as ordinarily applied, refers to those motors in which the inductance of either the field or armature winding is neutralized by counter current in an additional winding placed in inductive relation to the corresponding coil. In this class falls the motor whose field inductance is counteracted by a short-circuiting connection through brushes on the commutator in line with the field magnetism, the current induced in the secondary brush circuit when the armature is stationary being in phase opposition to the current in the field coils. (Latour motor.) This class includes also that type of motor which uses a short-circuited coil placed upon the field core in an inductive position with respect to the armature winding and in which the current produced by transformer action opposes in magnetomotive force the armature current and thus nullifies more or less completely the active inductance of the armature. (Eickemeyer, Steinmetz, Lamme.) The type which the General Electric Company uses differs from the latter in that the current in the compensating coil, instead of being produced inductively, is caused to flow therein on account of the fact that the compensating coil is connected in series (opposition) in the main motor circuit. Thus the compensation in this third type may be designated as "forced" in distinction to that of the other two types, which is "induced."

The circuits of the motor are represented in Fig. 2, from which it will be seen that the armature, field and compensating circuits are connected in series. If the effective turns of the compensating coil be equal to those of the armature, the resultant inductance of the two will be represented by the small leakage effect of the magnetism around the individual turns of each coil and will be prac-

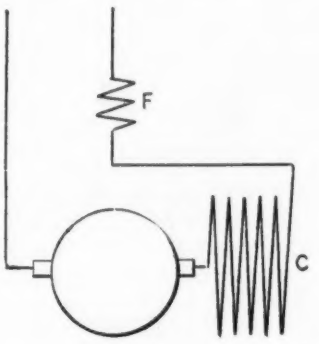


FIG. 2.—SERIES MOTOR WITH COMPENSATING COIL.

tically negligible, so that, if the inductance of the field coil be made small, the total inductance of the motor circuits will be correspondingly small, and the power factor at any operating speed will be relatively high. While in the induced type of compensated motor the secondary current can never quite equal the primary in magnetomotive force, in the forced compensated type the compensating coil can be given any value of magnetomotive force relative to the armature and the machine be overcompensated if desired, certain detrimental effects being produced, however, when the overcompensation is excessive.

Such a motor as the one here described is well adapted to operation by direct current, the commutation being practically perfect on account of the fact that the field distorting effect of the armature magnetomotive force is balanced by the magnetomotive force of the compensating coil when the turns on each are properly related. The compensating circuits of the machine being in all respects equivalent to the balancing coils on the early Ryan type of non-sparking, direct-current machines, projecting poles with commutating tips are not required for holding the field magnetism in the proper mechanical position. The service tests demonstrated that the commutation for direct current is beyond criticism and for alternating current it is satisfactory.

In the operation of the motors it is found that the best proportion of turns on the field winding for alternating current is different from

FIG. 3.—EXTERNAL VIEW OF MOTOR.

that for direct current, a commutating switch which is thrown to one or the other positive according to the current to be used allows the two sections of field coils of each motor to be connected in parallel or series as desired. In connection with the commutating switch are used two main line oil switches in the alternating and direct-current circuits, the switches being operated by a handle movable from the combination main line switches to the commutating switch, so that the commutating switch can be operated only when both of the other switches are open, and only one of the main line switches can be closed at a single instant.

The standard car equipment contains four motors, each two being operated as a unit through the commutating switch, and the two units are governed for speed by means of a standard K-28 direct-current, series-parallel controller arranged for two motors, resistance being employed to vary the speed when either alternating or direct current is used. The two armatures and balancing coils of the motors of each unit are permanently connected in series, while the field coils of each motor are divided into two parts, a part from each motor being placed in permanent connection with a similar part from the other motor, the two field sections of the unit being joined in series or in parallel according to the nature of the current to be used. (See Fig. 4.)

Due to the change in the interconnection of the field coils, the motors operate at practically the same speed when a direct e.m.f. of 250 volts per motor, or an alternating e.m.f. of 200 volts per motor is used, as seen in Figs. 5 and 6.

A comprehensive comparison of the performance of the equipment when operated by direct and by alternating current can be obtained from a study of Figs. 9 and 10, and an inspection of the following table of test data:

COMPARATIVE DIRECT AND ALTERNATING CURRENT RUNS.

	Direct.	Alternating.
Length of run; miles	1.6	1.6
Weight of car; tons	31.55	31.55
Time; seconds	180	180
Average current power on; amperes	229	346
Average voltage	606	425
Volt-amperes full speed on level	98	110
Volt ampere hours per ton mile	86.3	125.5
Average speed; M.H.P.	32	32
Schedule speed including 15 sec. stop	29.5	29.5

As stated previously, the motors are supplied with alternating

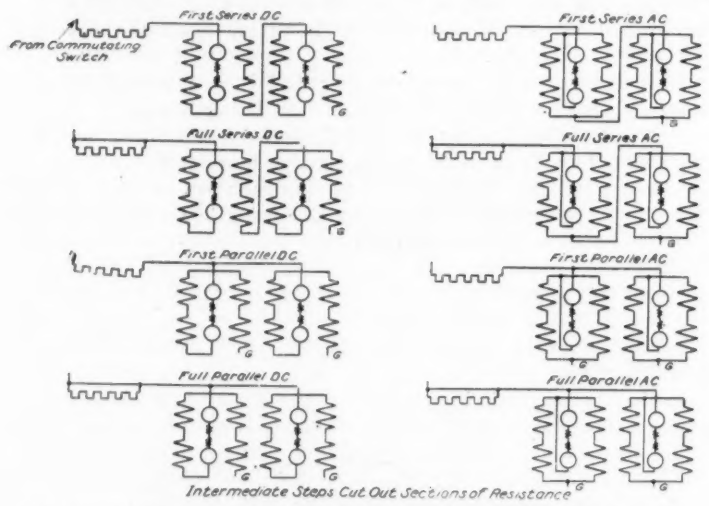


FIG. 4.—CONNECTION FOR MOTORS IN DIRECT AND ALTERNATING-CURRENT SERVICE.

current at 200 volts per motor or 400 volts per unit of two motors. This value of e.m.f. is obtained from the secondary of an 80-kw transformer, whose primary is connected directly through the oil switch to the 2,000-volt trolley circuit. The transformer is suspended from the car body and is cooled by the enlarged corrugated sections of the outer case, which are exposed to the circulation of air when the car is in motion, in a manner quite similar to the practice with the cooling coils of automobile engines.

The brakes for the car are operated by air, the compressor for which is driven by a compensated series motor fed with either direct or alternating current. (Fig. 12.)

Owing to the fact that the car must operate over the route taken by other cars driven exclusively by direct current, it was not practicable to substitute high-voltage, alternating-current conductors for the regular trolley wires, so that in the erection of the additional trolley wires several novel features were introduced. The direct-current trolley and feeder conductors have not been disturbed. Over 11.6 miles of the 15.5 miles between Schenectady and Ballston additional No. 4-0 wires were strung and fed at one point with 25 cycles alternating current at 2,200 volts. Upon the regular center poles spaced 100 ft. apart were placed 5-ft. cross arms, holding on each end high-potential cloaked porcelain insulators, similar to the ones used on transmission circuits. On these insulators were strung two 3/8-in. steel cables, from which were suspended the high-potential trolley wires clipped to the steel cables midway between the poles. While this catenary construction is exceptionally flexible and gives the best of insulation to the high-potential conductors, it is believed that, where only alternating-current wires are used, standard trolley line construction as now employed with direct-current equipments will prove entirely adequate.

Measurements have been made to ascertain the relative resistances

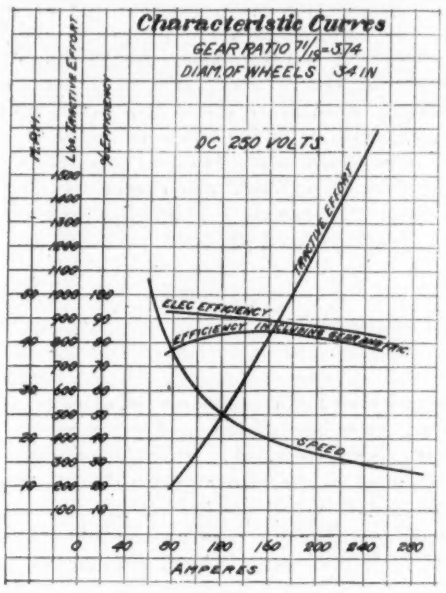


FIG. 5.—PERFORMANCE OF MOTOR WITH DIRECT CURRENT.

of the trolleys and tracks for direct current and for 25-cycle, alternating current, as recorded in the following table:

COMPARATIVE RESISTANCE OF TROLLEY AND TRACK FOR DIRECT AND ALTERNATING CURRENT—OHMS PER MILE OF CIRCUIT.

	Direct.	Alternating.	Ratio.
Two trolleys in series	.318	.417	1.31
One trolley and double track	.167	.259	1.55
Two trolleys and double track	.088	.155	1.76
Double track alone	.0174	.114	6.55

The resistance of the trolley wire is somewhat reduced by the steel cable in parallel with it. The track is laid with 75-pound rails, well bonded and tied together every 1,500 ft.

The presence of parallel direct and alternating-current trolley wires has rendered possible an immediate comparison of the performance of the car equipment when driven by alternating and by direct current under conditions equivalent in all respects. The test

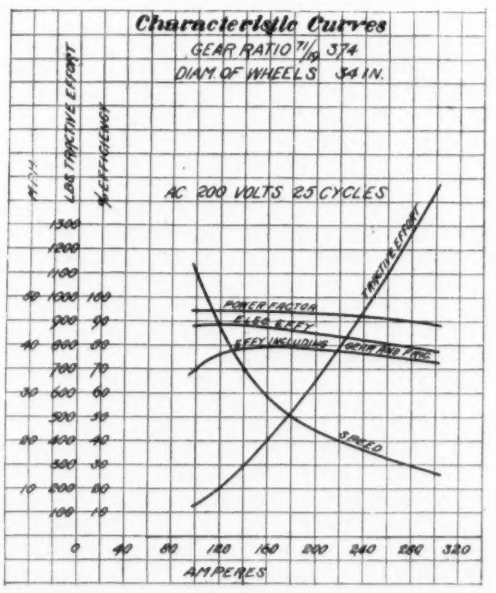


FIG. 6.—PERFORMANCE OF MOTOR WITH ALTERNATING CURRENT.

run mentioned previously was taken over a tangent level section of the track covering a distance of 1.6 miles.

A frequency of 25 cycles has been chosen so as to conform with present standard practice, with power circuits. A lower frequency would show improved performance of the motors, but would necessitate addition expenditure for transformers both for the transmis-

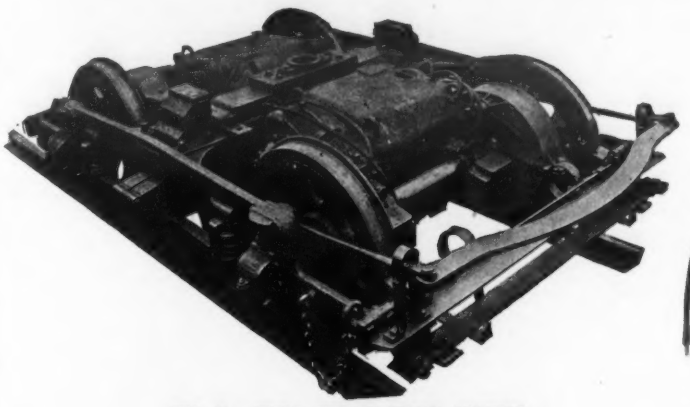


FIG. 7.—BRILL TRUCK WITH MOTORS

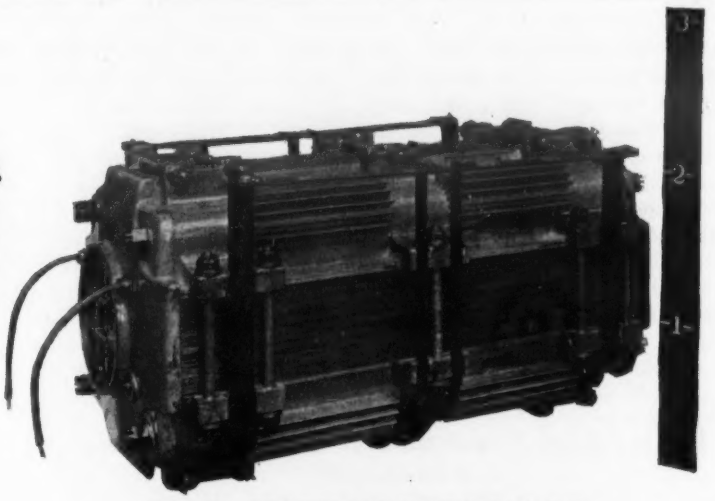


FIG. 11.—STEP-DOWN TRANSFORMER ON CAR.

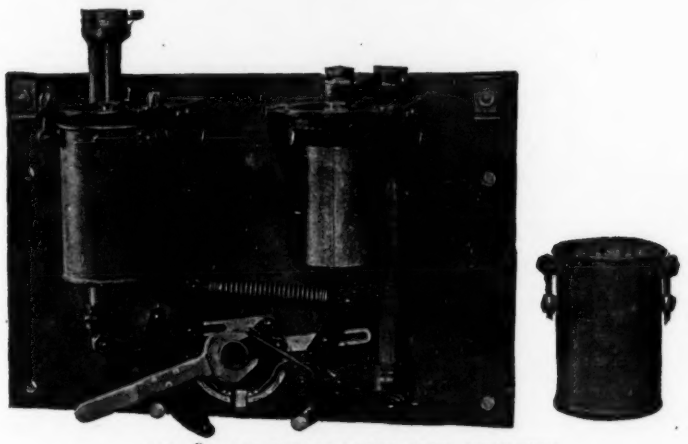


FIG. 8.—OIL-BREAK MAIN LINE SWITCHES.

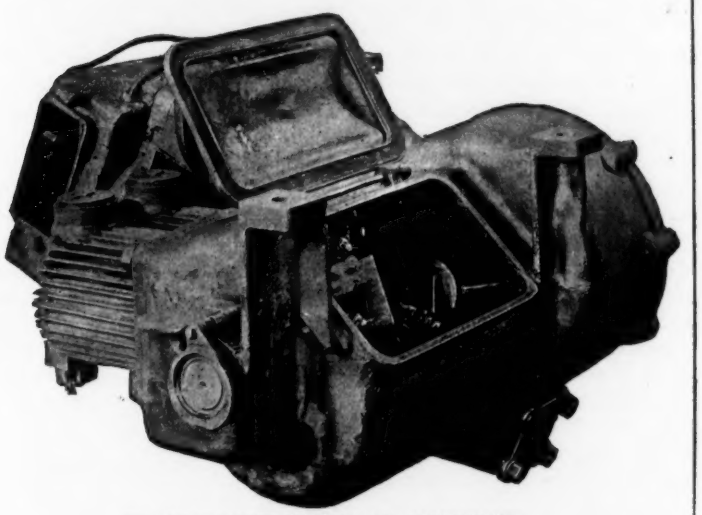


FIG. 12.—MOTOR-DRIVEN AIR COMPRESSOR.

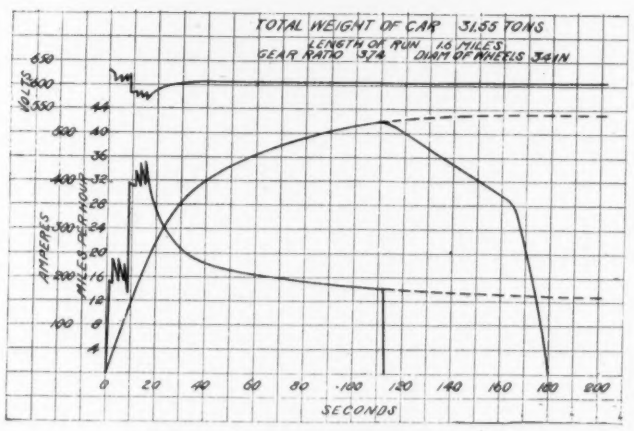


FIG. 9.—SPEED TIME CURVES, DIRECT-CURRENT RUNNING.

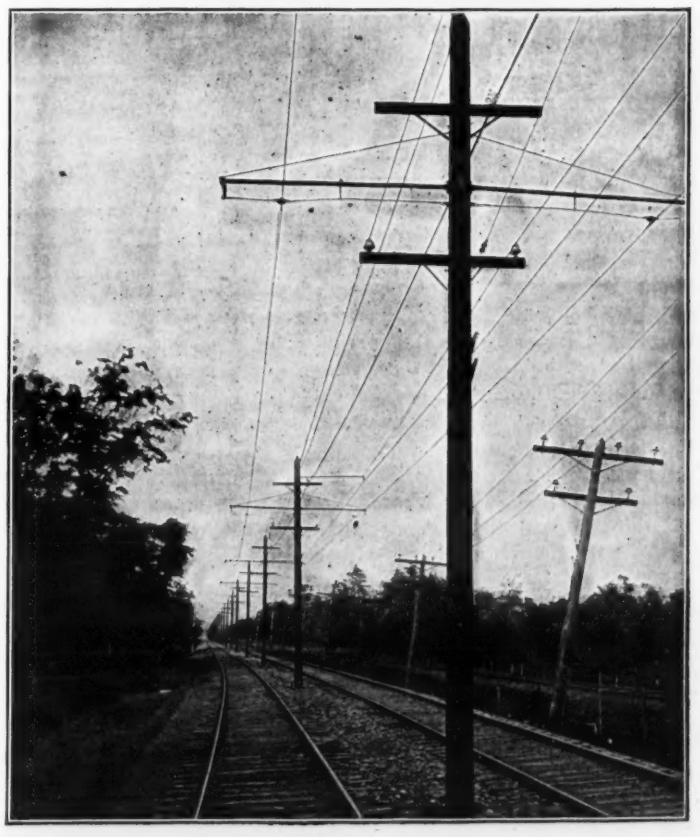


FIG. 13.—CATENARY LINE CONSTRUCTION.

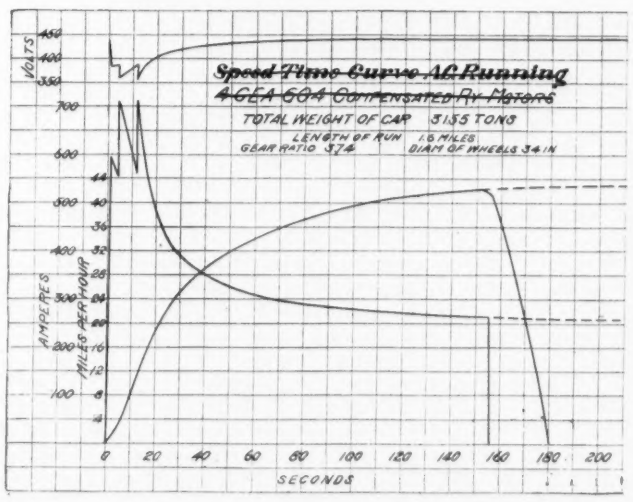

Speed Time Curve AC Running
4 GEA 604 Compensated Ry Motors
TOTAL WEIGHT OF CAR 315.5 TONS
LENGTH OF RUN 1.6 MILES
GEAR RATIO 37/4 DIAM OF WHEELS 34 IN
VOLTS
AMPERES
MILES PER HOUR
SECONDS

FIG. 10.—SPEED TIME CURVES, ALTERNATING-CURRENT RUNNING.

COMPENSATED MOTOR EQUIPMENT AND CURVES.

sion line and for the car itself. When the power is obtained from polyphase generators, advantage can be taken of the ability to feed alternate insulated sections of the trolley from separate phases of the two-phase lowering transformers, therebjy dividing the load upon the system more or less equally among the phases of the generating equipment.

That the system as adopted by the General Electric Company meets the severe requirements for combined direct and alternating current, urban and interurban service has been amply demonstrated, the cars being capable of operating over existing city tracks without in any way sacrificing their running qualities upon suburban sections equipped with alternating-current trolley fed from high-tension transmission circuits.

Tenth Annual Convention of Ohio Electric Light Association.

THE tenth annual convention of the Ohio Electric Light Association, held at Sandusky, Ohio, on August 16, 17 and 18 last, added another to the always interesting meetings held by this association. A large number of the older members, from various causes, were unable to attend, but their places were filled by an unusually large number of new faces, while the supply men and manufacturers were largely in evidence.

Mr. J. H. Perkins, general superintendent of the Youngstown Consolidated Gas & Electric Company, elected last year as vice-president, presided over the sessions, the president, Mr. S. M. Rust, formerly of the Piqua plant, but now with the Hobart Electric Manufacturing Company, of Troy, Ohio, having resigned his office as president upon leaving the ranks of active membership. Mr. S. S. C. Ayres, superintendent of the Greenville Electric Light & Power Company, in the absence of Secretary Gaskill, filled his chair. Much regret was expressed that Secretary Gaskill, owing to the serious illness of Mrs. Gaskill, was kept away, as his large acquaintance and familiarity with municipal and legislative conditions throughout the State make his presence very valuable aside from personal considerations of good fellowship.

An interesting feature of the social side of the meeting was due to the supply men in attendance, and consisted in the ceremonies attendant upon the rejuvenation of the Sons of Jove, a convention "secret society" among electrical men, originated in the Southwest. The first rejuvenation north of Mason and Dixon's line was held at Sandusky during this convention, and was highly successful. Paraphernalia from the Grand Lodge was imported for the occasion, and every accessory that would add zest to the initiatory services was called into play. The official roster for the installation of new candidates was Jupiter, Frank Warren; Neptune, W. D. Packard; Pluto, P. R. Boole; Assistant Pluto, W. J. Hanley; Vulcan, Philip Case; Mercury, E. E. Schmid; Hercules, Clarence A. Delafield; Mars, E. E. Kuhlman; Assistant Mars, J. A. Muir; Apollo, W. W. Lovell; Avrenim, T. Bailey Whipple.

The first session was held of the convention proper at 2.00 p.m. on Tuesday, the morning being given to registration. Messrs. S. M. Rust and W. J. Hanley were appointed sergeants-at-arms and Mr. C. M. Hart, of the Sandusky Gas & Electric Company, was made chairman of the Ladies' Entertainment Committee. He was assisted by Mrs. H. B. Warren, chairman; Mrs. W. Beupel and the Misses Bernice Warren and Lenhart.

President Perkins, who has established a reputation as a close student of details looking to greatest economy of operating expense, in his address pleaded for greater attention to the matter of full records of operating data from all departments.

SINGLE-PHASE VS. POLYPHASE MOTORS.

In a paper entitled "A Dayload as a Factor in Central Station Earning Capacity," Mr. Lehman B. Hoit presented figures and curves favoring the single-phase over the polyphase motor for power distribution. It is stated that practically all large central stations generating two or three-phase current use single-phase motors, and the general opinion is that eventually the practice will be to use the latter in preference for all capacities up to and including 40 hp. The excess of cost of polyphase motor transformers is stated to be from 25 to 50 per cent. greater than that of single-phase transformers. The loss on transmission of current is much greater, this also requiring large transformers. Data of Wagner single-phase motors are given in the form of curves, and a list of large plants using such motors. Referring to charging rates, it is stated that the Chicago Edison Company employs a rate system laid down as a curve; according to this system, the charge for a 4-hp motor running four hours per day at full load is approximately 7½ cents per kw-hour; and 4¾ per kw-hour if running ten hours daily.

TRANSFORMER TESTING FOR CENTRAL STATIONS.

Mr. S. E. Johanneson contributed a lengthy paper on transformer testing for central stations, which treated of the subject in great detail. The paper opened with a discussion of general considerations and then proceeded to describe the various tests. Each test is prefaced with consideration of the electrical principle involved and a discussion of the principles of the test. Instructions in detail are then given for making the test and examples added showing their application.

In the discussion of Mr. Johannsen's paper, Mr. Conn, of Lynn, Mass., said that in transformer testing some engineers prefer to make their tests with water rheostats. As to copper loss test as arrived at by calculation or by measurement, he agreed that the difference in results arrived at depends more or less upon the transformer design. Readings by wattmeter always go above that derived from calculation, probably 10 per cent., provided the transformer windings are in perfect condition. Mr. Conn believed it preferable in calculating the regulation of a transformer to determine the copper loss by wattmeter rather than by calculation. On commercial tests the practice of the speaker was to use the circulating method on tests made before sending out the product, and only on special test to employ the wattmeter. Mr. Randall considered that calculated results will agree more closely with the actual values than test results.

CENTRAL STATIONS AND SUPPLY HOUSES.

Mr. P. R. Poole, general sales manager of the Electric Appliance Company, presented a paper entitled "The Relation of the Supply House to the Central Station." He dwelt upon the benefit to central stations from the great variety of stock carried by supply houses, which enables an order for many different items to be filled where otherwise it might be necessary to send to a different factory for each. A large supply house carries about 16,000 items, and it is stated that Edison base material accounts for 182 items alone.

Mr. Hillman said that such a paper should be printed by all means, and that he would like to have seen it include also plans for house wiring. It is very natural for a supply dealer to show such plans, and if he can present forcible arguments in regard to house wiring, and encourage the central stations to follow suit in connection with circulars and appliances put out by them, it will not be long before all new houses will be wired for all kinds of electric household appliances. To-day it is common knowledge that houses and buildings are wired mostly for lighting only. When wiring shall be done with a view to other uses of the current, the supply houses will at once begin to feel the beneficial effects in increased business.

ELECTRIC HEATING.

Mr. H. W. Hillman presented a paper entitled "Relation of Electric Heating Devices to Central Stations," which describes a line of General Electric heating apparatus, a score or more utensils being illustrated in the pamphlet distributed at the convention. It is urged that central station men should become acquainted with the handling and cost of operating electric heating devices. Electric cooking, baking and ironing for a family of four or five people, it is stated, will cost an average of only $4 per month. The conclusions of the paper are that there is a tremendous field for a large business in electric heating, and central stations should organize heating departments.

In connection with the presentation of Mr. Hillman's paper, utensils themselves were many of them on exhibit in the display made by the General Electric Company. Considerable discussion followed, Mr. Hillman giving details of experiences in his own family with the use of various devices, and urging that central station people try the various apparatus in their own homes in order to acquire the widest range of familiarity with them. Mr. Perkins thought that in order to insure their adoption by people generally, cooking apparatus using electrical current must appeal to the pocketbook of the consumer in economy of current; also, that it might be well to devise either a double wiring that would provide for two classes of use, as is the case with fuel and illuminating gas, or some means to offset the disadvantages met with in the cooking of meals

at the peak load. The electric oven when tried in the household of Mr. Gwynn had not proved satisfactory to the culinary department, because of slowness. Mr. Gwynn thought if electric cooking were generally adopted most stations would have to greatly enlarge their capacity. Mr. Hillman had not found this difficulty in his experiments. The oven should be heated in advance to the requisite degree before placing the loaves in it, and he had seen excellent results obtained. He had kept a careful record of current consumed in his home for cooking purposes, and the results showed that 56 per cent. of the current so used was taken between 10.30 a.m. and 2.00 o'clock during the day, and 36 per cent. of it was taken between 6.30 and 10.30 a.m., and only 11 per cent. taken between 4.00 p.m. and 8.00 p.m. That would be an ideal situation, but he hardly thought it was fairly representative, and that probably in the average case more cooking and baking would be done on the peak of the load of the central station.

Mr. Clohesey said that most servant girls are deadly afraid of the use by them of anything electric, and asked what Mr. Hillman thought as to the reliability of the various forms of heaters and ease of restoring fuses without causing any alarm on the part of the servant, improvement in which respects he thought would speed the day when electric heaters would be generally adopted. In reply, Mr. Hillman cited an instance of what could be done in a recent improvement in flatiron construction, so that when attached to a chandelier and carelessly dropped, by means of an appropriate spring attachment it is impossible to break the contacts out. Mr. Turner asked how, with a tremendous heating business, the maximum going on at 6 o'clock in the morning or at noon, could the central station be responsibly expected to give a lower rate at noon than 6 o'clock in the evening? He granted that the heating load would earn a lower rate, just as the motor load had earned a lower rate, but in neither case should this be on account of the time of the maximum load, but because of the length of time used. Almost all these devices cross the maximum load on the station, because especially in winter in the cities the maximum starts up on dark days along about half-past 2 or 3 o'clock. As we build up the motor and heating load, the load curve will flatten. Users should pay for their proportion of standing charges, whether their maximum comes at 12.00 noon, or 6 at night. Some sort of cooking is done almost all day long during the summer months. Mr. Clohesey seemed to think that the question of "peak" had been made too much of a bogey in the past, and that when business developed at any time of day in sufficient amount, requisite machinery and equipment would be developed to take care of it; he was rather concerned with the question of the reliability of heating and cooking devices, rates and the other phases of the matter, as the distribution of the load would take care of itself. If people through the reliability and convenience of these new electric devices can be induced to adopt them gladly, the demand will be established, and station men will find a way to meet it. As to what could be done in the way of educating a demand, he instanced the work done in Cincinnati by the local plant there in establishing a school for demonstration of the utility of gas stoves and the success that had attended that enterprise. Heating and cooking electrical devices will be adopted many times, not because of their economy alone, but because of their desirability and convenience, when reliable in action. It is up to the manufacturer to make them so within reasonable limits. He predicted in the next five years an extraordinary development along these lines. Mr. Jackson thought that even if accepted by users as safe, the question still remained open as to whether the cost would be prohibitive or not, and he urged that careful investigation be made to ascertain what rate should be charged for such service, and whether it was possible to supply current cheaply enough to justify exploiting the devices; station men should know first what it is going to cost before deciding whether they can sell it or not. Mr. Clohesey thought it was a very easy matter to determine this, and that the consideration of the question of rate was secondary at this time. Mr. Perkins said that he thought the contention of Mr. Turner and Mr. Jackson was that it should cost a different amount, dependent upon the time of use during the day as compared with other demands. Mr. Turner thought it would be highly inaccurate to infer simply because the average cost of current might be placed at 5 cents and sold at 7, 8 or 10 cents that a reasonable profit could not be derived at low rates in special cases. The present question was, Can these cooking and heating devices by electricity be used to supersede the present methods of heating and cooking by coal and gas stoves? Mr. Ayres agreed with one of the previous speakers that perhaps too much stress had been laid on the peak of the load proposition in the past few years; in his city (Greenville) they had a system which took care of that question very nicely. There are a large number of costs to the central station that are in no way dependent upon the amount of current produced, but are measured by the size of the station or its capacity to produce a maximum amount. Such are officers' salaries, dividends and a large number of costs of that kind. In his city the central station divided costs under two general heads. In one column are placed all costs that do not vary with the amount of daily consumption of current, but vary simply with reference to the size of the station; and in the other column all costs that vary with the amount of current produced. As a result, after examination and deductions made, it was found that the cost per month of connected load, provided it was turned on at all times, was $3 per kilowatt; accordingly, consumers are charged $3 per kilowatt per month of connected load, and in addition a charge is made at a uniform rate for hours turned on, which latter charge varies with the amount per month consumed. Both the consumers' and the company's interests are served, and the rates are mutually satisfactory. The consumer finds his bills are more uniform throughout the year, which suits him better than on a meter basis, and the company is likewise protected because the arrangement is an equitable one.

THE MAGNETITE ARC.

In a paper entitled "The New Luminous Arc Street Lighting System," Mr. H. W. Hillman, of the General Electric Company, presented the claims of the magnetite luminous arc lamp. He stated that 300 lamps of this system have been operating satisfactorily at Jackson, Mich., for three months. Some lamps sent to Portland, Ore., where they have been operated by the station force without expert aid, have been giving satisfactory service, and a contract in another case has been closed for 800 lamps after a three weeks' trial of the lamp. This includes multi-circuit Brush arc machines wound for 4 amp., with a voltage of 11,250 and accommodating approximately 135 magnetite lamps.

It is claimed that the luminous arc gives an effective illumination 30 per cent. greater than the enclosed arc, either series or direct, and that the new Brush machines have an efficiency of 88 per cent. The life of the lamp electrodes is from 150 to 175 hours. The voltage at the arc is 75 to 80 volts. Only one electrode is renewable, and this can be quickly replaced. The lamp is not designed for interior service or to operate on alternating circuits or on 110-volt, direct-current circuits.

In the discussion following Mr. Hillman explained some points in connection with the details of construction not made plain in his paper, and in reply to a question from Mr. Bechtel as to whether the saving in trimming justified the sacrifice in light, said that he believed if he were personally operating a plant that he would take the 150-hour electrode and give the city the benefit of the better light; the difference between 150 hours and 500 hours might make a difference of one man only, which, estimated at $600 a year, would mean on, say, 600 lamps, $1 each, which was unimportant when weighed against considerations of pleasing the people with the light. He believed in giving the city all the benefits in a case like that. As a matter of fact, the best street lighting he had ever seen was with mercury arcs, the lights taking only 140 watts and giving a beautiful distribution of light, and very pleasing to the eyes.

In reply to a question as to in what respects the light was best, whether because of intensity, or the color of the light, Mr. Hillman replied because of the intensity and distribution. There are no heat rays in the mercury arc, which can be proven by using the radiometer, but it gives a mild light peculiarly grateful to the eye, and the distribution is after the manner of daylight, of a mild form. Mr. Wallo asked as to the relative effect of the luminous and the ordinary open or enclosed arc, when driving along a street, whether the midway spaces are not rather dark by contrast in spite of the apparent distribution? Mr. Hillman did not claim to have overcome this feature to any greater extent than with the ordinary open or enclosed arc lamp. Salesmen in the introduction of the closed arc had met with difficulty in educating people that it gave as much light as the open arc, and the campaign of education was not yet entirely concluded, and somewhat the same situation might present itself in introducing the new luminous arc lamp. In Harrisburg, Williamsport, Brooklyn, Newton, Schenectady and a dozen different places, the results had been most satisfactory. Mercury arcs should be used for suburban districts and in parks and all places

where foliage abounds, especially during the summer season. The green light enhances the beauty of the foliage and intensifies it. Mr. Turner asked if the geraniums would not look pretty black? The speaker said they would perhaps look like violets, but the whole subject suggested the advisability of establishing the profession of illuminating engineering to study the various conditions of lighting effects. Park lighting was as much a peculiar study as department store lighting had proven in the past. The public had now become educated to the fact that you could not select blue silks under an incandescent light, etc., etc. To bring out the beauties of tree foliage the speaker suggested the placing of lamps low and without any reflector, so the light would go up in the trees. He had seen beautiful effects produced in Dr. Steinmetz's garden by the employment of the mercury arc; but over his geranium bed he had the "Meridian" lamps installed, and where he has installed the mercury arc he has taken pains that the green foliage is there.

SHUNT BOX SYSTEM OF INCANDESCENT STREET LIGHTING.

In a paper entitled "Notes on Incandescent Street Lighting," Mr. K. C. Randall described the Westinghouse system of series incandescent street lighting. Both the shunt box and regulator were treated in considerable detail, including instructions for special cases. The shunt box system was stated to be adapted to circuits ranging from 1,000 to 3,300 volts and its chief features are summarized as follows:

There are no moving parts, contacts or anything mechanical. The action of the shunt box is entirely automatic, certain and instantaneous. Each box is a unit in itself, assuming the place of a defective lamp, or again assuming its normal function when the lamp is replaced without any adjustment whatever. Any number of lamps may be operated, the only limit being the capacity of the generating station. Lamps of different candle-powers may be operated on circuits by themselves or with lamps of greater or less candle-power current consumption or voltage. By means of control outfits, special circuits carrying an odd number of lamps may be operated at the same high efficiency as the regular circuits. The percentage of current required to keep the shunt coils magnetized is very small and but little energy is consumed for this purpose; hence, the entire system is operated at a high efficiency and power factor, which is maintained irrespective of the number of lamps used.

In this system the repulsion coil type of transformer may also be used to give a constant current and to insulate the line from the primary current. With this transformer any incandescent load will give a power factor of about 98 per cent. at full load, and the use of taps will maintain this power factor at 70 per cent. of the load.

The general conclusions are that the shunt box system is the cheaper for about 70 25-cp lamps or for about 100 50-cp lamps. The losses of the shunt box system are lower at small capacities up to 12 kw of 25-cp lamps, and much lower than the regulator system up to 20 kw when using 50-cp lamps. The shunt box is more flexible for incandescent work, but where both arc and incandescent lighting is to be done, the regulator system is preferable.

The regulator system is inferior for small capacities, but superior for large capacities, depending on the size of the lamp used. The power factor and efficiency of the regulator at full load is high and falls as the load is reduced, while that of the shunt system remains constant for all loads.

Considering cost and performance, the regulator system is inferior for small capacities, but superior for large capacities, depending upon the size of lamp used. In some instances a station could use both systems to advantage. For example, when a few alley incandescent lamps were needed, the main load being arcs.

In the discussion of Mr. Randall's paper, Mr. Perkins asked if the series transformers used where both arcs and incandescents are on the same circuit could be inserted anywhere in the circuit? The writer replied in the affirmative, but if the circuit is of any considerable extent it might be better to have a second coil of the regulator for the incandescent circuit. Additional lightning protection in a long circuit should be provided.

A paper was read by Mr. E. H. Haughton, entitled "Notes on the Incandescent Lamp." In conclusion, the writer called attention to the beautiful exhibit by Mr. W. J. Hammer, at the St. Louis Exposition, showing the origin and evolution of the incandescent lamp down to the present time.

The Symposium on Central Station Heating, which had been arranged, owing to the absence of the participants at this time, was postponed to a later session, and finally altogether abandoned.

Mr. T. Bailey Whipple asked apart from the subject if any one present could state offhand about what the lamp renewals were per thousand kilowatt-hours in the central stations represented at the meeting?

Mr. Haughton replied that he had some data from Mr. Van Ness, with the McMillan interests, to the effect that with lamps at 16 cents each, with 420 hours of life to smashing point, renewing every 70 days, the cost of lamps per kilowatt-hour is $.76; cost of renewing per kilowatt-hour, $.071. A 3½-watt lamp, 750 hours to smashing point, 125 days as the period of renewal, costs, per lamp per kilowatt-hour, $.38; cost of renewing per kilowatt-hour is $.36. Mr. Wilcox, of the General Electric Company, advocates the use of a lamp even higher in efficiency than 3 watts per candle, and that a 3.1-watt per handle lamp should at least be supplied in central station service. Mr. Van Ness assumes a 3.1-watt lamp to have a life of 420 hours, and a 3.5-watt lamp to have a life of 750 hours. His conclusions, Mr. Houghton stated, are based not on the results of actual practice, but is an estimate which the speaker thought might be accepted because of the fact that Mr. Van Ness made the life of a lamp seemingly short, 420 hours being a moderate estimate for 3.1-watt per candle. In reply to a question, Mr. Whipple said that his company guaranteed 8,500 candle-hours on a 3.1-watt lamp of double-filament type, and 7,500 candle-hours on oval anchor type. He thought that to guarantee 600 hours life on a 3.1-watt lamp was promising an impossibility, and that lamp people should be more conservative in their guarantees. The discussion became somewhat heated, and was brought to an abrupt conclusion, an adjournment being taken at this time.

THE CROCKER STEAM TURBINE.

Mr. E. C. Crocker, in a paper entitled "The Steam Turbine and Its Use," described a type of turbine of his invention, which he stated would be placed on the market by the Warren Electric Manufacturing Company.

The turbine is built on the principle of expanding steam in a diverging nozzle down to a given pressure, where it impinges on the first set of blades or buckets fastened to a revolving disc. It is then received by a stationary set of guides, which further expands the steam and directs the flow on to a second set of blades or buckets fastened to a second revolving disc, and so on successively until the steam is delivered to the exhaust in nearly a stationary condition. After a number of experiments on making nozzles to get as nearly a true expansion as possible following the curve line of the steam it was decided that the best method is to cast a solid bronze ring and cut the diverging nozzles out of the face of this ring; instead of a nozzle with straight walls this gives one which, while following the expansion of steam, at the same time follows the circle of the ring, thereby approaching very nearly the natural curve line of expanding steam. An automatic machine has been made for cutting these nozzles. After this operation and after the ring is turned off, another solid bronze ring is shrunk on to the outside, thereby closing up the side of the nozzle and making it complete. This nozzle ring is then set into a circular steam chamber, forming one of its walls, and is so arranged that the steam discharges from it on the buckets arranged around a circular disc; and as these nozzles follow each other around the complete circle, the entire set of buckets is filled with steam when the turbine is working at its maximum load. An automatic arrangement is provided, whereby one or more nozzles are automatically cut on or off, as variation of the load may require, thereby giving the turbine an efficiency at part load, which is very nearly equal to the full load efficiency. By this method of control the steam is never throttled, except at the nozzle the governor is operating on, the rest of the nozzles being either entirely closed or doing a maximum amount of work. It is very essential to get the correct shape of nozzles in order to get the highest degree of efficiency from the turbine, and it is also essential that the buckets and guide vanes should be made of the proper radius and angle and so proportioned that the reaction of the steam shall counterbalance the end thrust due to the difference of pressure between the first set of buckets and the exhaust end of the turbine. The proportions should be such that there will be a slight excess of thrust, which a thrust bearing can easily take care of.

The speed of the turbine is regulated by a centrifugal governor, which forces a pin against a cut-off valve connected to the exhaust chambers of a small steam cylinder. This cylinder has a piston which is directly connected to a cut-off ring inside of the steam chest of the turbine. This ring is held against the face of the inlet side of the nozzle and has holes in it of different lengths, whereby any

movement of the cylinder cuts on or off certain nozzles according to the direction of the movement of the piston. So close a regulation is gotten by this method that 2 per cent. is guaranteed, and it can be controlled so that it may operate with 2 to 6 per cent., as the conditions under which the turbine is to operate may require. The cut-off ring is only used on the smaller sized turbines from 100 to 300-kw capacity; on the larger sizes the steam enters a governing receiver which acts in the same manner. This receiver has a hollow balanced port valve. This valve controls the opening to different sections of the steam chest of the turbine, and one or more openings are made or closed according to the load, in the same manner as in the smaller turbines. The whole turbine is complete in every detail, being mounted on an iron sub-base, has a pump for forcing lubrication through all the bearings; no oil being used in connection with the internal parts of the turbine allows the use of the condensed steam direct to the boilers, without the use of a separator. The buckets are made of drop-forged steel and dove-tailed into steel discs, the whole being finished by grinding before it is assembled.

The attendants at the convention were given a convenient opportunity between sessions to inspect the operation of a turbine at the Warren Company's plant. After reading his paper, Mr. Crocker was asked as to what would happen in case of a boiler priming and water getting into the turbine; he replied that it would not do to use wet steam continuously, as it would wear out the buckets, and decrease the efficiency, but the priming of a boiler would work no bad effects in particular except to slow down the machinery. In reply to further questions by Mr. Bailey, the speaker stated that his company were building 300-kw machines at present, the largest size, and had one in use at its factory, geared to a shafting for testing belted machines. The guaranteed steam consumption of a non-condensing turbine of 300-kw capacity on 150-pound steam is 28 pounds steam consumption per brake horse-power. The friction on a turbine amounts to very little. About 15 pounds steam per horse-power-hour is used by the 300-kw machine. Mr. Clohesey asked if the speaker recommended the operation of his turbine at about 150 pounds pressure, and an affirmative answer was given. The pressure on the exhaust would be practically nil, just enough to overcome the atmosphere. The regulation was 2 per cent. He did not claim that under the highest conditions of a Corliss he could compete with it in economy, but there are other advantages that make a turbine much more desirable than a Corliss engine for electric work; it is much more economical in space, using less cylinder oil, and having less wearing parts than a reciprocating engine. Up to 300-kw size, 3,600 revolutions speed was obtained; on the 500-kw size, drop to 1,800 r.p.m.

In answer to a question whether, owing to the small cross-section of the vanes, liability to accident would not result by the introduction of foreign material into the working parts, he said that such liability did not exist, as it is practically impossible to break a vane unless purposely done; they are constructed of drop forgings and dove-tailed into a disc, and are butted together on the rim of the wheel and form almost a part of the solid disc. If anything should happen one can take off a piece on the side of the disc and move the vane out of its dove-tailing and slip in a new one. In reply to a question as to whether, if some of the guide vanes were broken out in between the rotating parts, trouble would result, he replied that there was an inch and a half space underneath the wheel into which the bucket would fall and do no damage. As to provision for taking care of the side stress on the ends of the buckets, the speaker said that the bucket being made in separate pieces allows them to expand so that the stress due to centrifugal force will do no damage. In reply to Mr. Bailey, he stated that there are, on a 300-kw turbine, four movable and three stationary guides; a nozzle ring takes the place of one set of guides. The end thrust is taken care of by getting an angle on the buckets so that the reaction of the steam takes care of it. There is a pressure of about a pound that is taken care of on the small turbine with a small thrust bearing which runs in oil; on the larger turbines a thrust is employed submerged in oil. The peripheral velocity of the 300-kw turbine is about 400 ft. per second. The Warren Company for this class of work is manufacturing a revolving-field alternator. In reply to a question he said that the steam turbine did not propose to compete with the gas engine on consumption of fuel, neither could the reciprocating engine do so. Mr. Clohesey stated that a new type of oil engine was guaranteed for two per cent. regulation, and a cost of 41 cents an hour for a 300-kw machine.

CENTRAL STATION TESTING DEPARTMENT.

Mr. Frank Conrad read a paper entitled "Instrument Equipment for Testing Department," in which he described the various types of instruments specially adapted for central station testing work.

For alternating-current work the induction ammeter and wattmeter are stated to be the best fitted. An ammeter and wattmeter of this type are described in detail. The paper also describes in detail types of ammeters, voltmeters and wattmeters which have been recently put on the market by the Westinghouse Company for use as standards in calibration.

CENTRAL STATION COSTS.

Mr. Mathias E. Turner, of Cleveland, Ohio, read a paper entitled "Graded Costs of Electric Supply," which dealt with the subject of analysis of central station costs. To illustrate, the case was taken of a 500-kw central station costing $200,000 and selling annually 450,000 kw-hours. All of the various costs, including labor, fuel, maintenance, general expense, taxes, etc., are, where possible, divided, and one portion charged to "standing" and the other part to "running." The total costs are $25,500, of which $16,000 is allotted to "standing" and $9,500 to "running"; or $40,000 and $8,500, respectively, including interest and depreciation. The amount properly chargeable to different classes of customers as the cost of their service per kw-hour, is then shown to range from 24.01 cents for a daily service of one hour, to 3.93 cents for 12 hours, and to 3.02 cents for 24 hours' daily service. Central station managers are advised to make close analyses of their costs in order to determine what is chargeable to different classes of services and thus prevent loading up with business at a loss and neglecting profitable business.

Messrs. Perkins, Dusenberre, Bechtel, Jackson, Ayres and others discussed the paper of Mr. Turner and President Perkins congratulated the association on receiving such a valuable contribution to this important subject, treated along the lines recommended in the opening address of the president.

SERIES CONSTANT-CURRENT ARC LIGHTING.

With the title "Points for Consideration when Purchasing Series Alternating-Current Arc Lamps," Mr. G. Brewer Griffin presented a lengthy paper in which he pointed out the merits of the "tub" system of constant-current series arc lighting and dealt in detail with the alternating-current enclosed arc lamp, its construction, efficiency, testing, insulation, maintenance, etc. A section is devoted to commercial operation, in which are considered amperage to be used, the height and distance apart of lamps for street lighting, how best to light streets having heavy foliage, line fittings, etc. The opinion was expressed that the air-cooled regulating transformer is the most satisfactory for sizes of 25 and 50-light capacities, and 100 lights when the circuits in the transformer are entirely separate from each other. This also applies to the 75-light regulating transformer where the secondaries are interconnected. The air-cooled regulator usually regulates somewhat closer than does the oil-cooled one. The oil-cooled regulator is preferred for 150-light regulators or two-circuit, 200-light regulators, or single-circuit, 100-light regulators.

In the discussion, Mr. Wallo stated that though not strictly within the lines of the paper, a valuable point that might be brought out is the operation of series arcs from a Brush machine driven by synchronous motor. Mr. Randall thought the same result could be more cheaply secured with a synchronous motor and transformer than synchronous motor and generator. Mr. Perkins said that at Youngstown they had found it necessary to have some inductive effect back of the regulator to make it steady.

UNACCOUNTED-FOR CURRENT.

With the above title Mr. W. E. Richards presented a paper in which he pointed out the several sources of lost current. The most important of these he stated to be that which occurs at the meter in the potential circuit and through meters running slow. In direct-current wattmeters the potential loss runs approximately 35 to 175 kw-hours per year, and in the induction type from 17 to 35 kw-hours per year. A tabulation is given showing that the loss of a commutator type of meter, after having been in use twenty-one months, was 37 per cent. at 1/20 load, 18 per cent. at 1/10 load, 8 per cent. at ¼ load, 3.5 per cent. at ½ load, 2.2 per cent. at full load. Even with the precaution of installing meters of a capacity as near the lighting load as possible, data collected shows a loss of from 12 to 18 per cent. on 1/10 load, and 5 to 8 per cent. on ¼ load.

Meter losses in unaccounted-for current can be reduced to a minimum only by an intelligent effort of the meter department, as upon the care and upkeep of the meter depends at least 10 per cent. of the earnings of the company. It is entirely practical to systematically clean and inspect meters, the interval of such cleaning and inspection depending on the capacity and service. To reduce the controllable losses on a meter system, of course, requires additional expense. Just where the balance of the additional expense and the reduction of the losses occur is a fine point to decide. If the meters are of the induction type, Mr. Richards' practice is to give them attention every eighteen months, but the commutator type requires an inspection every eight or twelve months. An inspector can clean up 1,800 meters per year, besides benefiting by information from visits to premises. It pays to keep constant check on large consumers, visiting these meters as often as once in 90 to 120 days. This frequent inspection has good effect, not only on the reduction of meter losses, but current lost from theft, which is also quite an item.

In reply to a question as to what percentage of current the Toledo office accounted for, Mr. Richards stated that they had not fixed on any certain percentage of loss to work on as a basis, but that the unaccounted-for current in the meter department stimulated investigation of that part of it. Mr. Bechtel stated that at Toledo they had two systems, one alternating and one direct; they account for about 92 per cent. of direct current, and about 80 per cent. of alternating current. Mr. Bailey thought the showing particularly fine, in which Mr. Perkins agreed. Mr. Bechtel further stated that about three years ago the loss in the alternating district was about 60 per cent.; most of the loss had been found in the transformers, due to old and obsolete types of transformers, which have since been changed to modern types of oil coil. The feeder system was gone over to some extent, but had not proved so important an item; the feeder drop did not exceed 5 per cent., and that upon the peak only.

Mr. Longnecker asked if any of the loss could be accounted for in any unsoldered joints, to which Mr. Bechtel replied in the negative. He supposed that bad joints, if they existed, would occasion the loss of considerable current, especially in the secondary line; but no such element had existed. Twenty-five kw is the largest transformer used; the largest interconnected secondary on alternating work has about 2,000 lines connected; the business district is entirely direct current and the secondaries on that cover about two and a half miles of street. A record is kept of all transformers on the line as an entirety. Mr. Bechtel agreed with Mr. Perkins in the latter's statement that the greater part of unaccounted-for current was in transformers and meters. Changes in transformers made at Youngstown had resulted in cutting down the core losses 66⅔ per cent. Mr. Bailey thought the average copper loss very small in stations kept in anything like decent condition. Mr. Valentine asked Mr. Bechtel how he arranged for the balancing of his three-wire secondary system circuits, to which Mr. Bechtel replied that this was more or less possible of accomplishment at time of connection with the consumer; and later on by inspection at times when visits were made to the premises for other purposes. Mr. Valentine asked whether, with the outlying districts, where alternating lamps were installed, any trouble was experienced with inductive drop, and if so, how overcome? Mr. Bechtel said they had not many alternating lamps multiple; when they had more than two they usually put on a separate transformer; the inductive drop did not amount to much in the primary lines, but was mostly confined to the secondary lines. Mr. Bailey stated that they had at Piqua about 300 incandescents and 6 arcs on separate transformers; the drop on the primary is about 12 per cent.; the power factor of the lamps runs from 63 to 68; he intended to put in a booster transformer to compensate for that. Mr. Bechtel had tried this plan and found bad effects from it at times of light load, unless one could cut the booster in as the load varies. Mr. Bailey asked if the last speaker had ever tried using two halves on secondary winding and putting one in series like a series transformer, and putting the other leg in series with the line. Mr. Bechtel said he had not. Mr. Perkins could not understand how Mr. Bailey could get a 12 per cent. drop in a primary lead on account of inductive current. Mr. Bechtel thought it did not look reasonable at 2,500 ft. from station, with 250 lights. Mr. Bailey stated the arcs referred to were on 20 to 30-kw transformers, No. 4 primary wire, high-frequency, 1,000-volt circuits; distance about 2,500 to 3,000 ft., wound for a 10 to 1 ratio; the transformers ought to give 115, but they only give 90. Mr. Perkins suggested that the trouble might be due to some bad arrangements of other circuits on the cross arms. He could not understand the drop of 12 per cent. Mr. Richards asked how he arrived at the percentage, and in reply Mr. Bailey said he used a voltmeter run across the primary leads; on the switchboard there is a 10 to 1 potential transformer; he got the constant on the station and ran a voltmeter across the primary turns of the transformer, and also took the secondary voltage.

At the close of the above discussion, President Perkins presented for consideration the following question: "I should like to know of some inexpensive and reliable way of testing a Thomson recording wattmeter without taking it out of service and moving to the testing room or laboratory at the central station."

Mr. Turner took the general ground that meter inspections should not be made on premises; if the object was to make a cheap test, the testing could be done at less expense in the testing room than on premises; there was greater percentage of error in testing on the premises and acceding to every trivial request to test a meter on premises had the effect of destroying confidence in meters, which have now reached such a high degree of accuracy and reliability that they are as accurate or more so than meters for any other form of public service. His experience was that a man at the central station laboratory could test on an average 25 meters per day, as against 8 or 10 on premises, and do it much more satisfactorily, including necessary repairs and adjustments. Inspection bureaus were going around offering to test customers' meters, and if tests are made by the companies at residences or places of business, it tends to encourage the belief that such testing is an easy matter, and anybody can do it properly, which is far from the truth. Meters tested at Cleveland had been found within 2 per cent. Mr. Gilmartin asked if a commutator meter in process of being transported to place after testing at central station would stay in the same condition that it was after test had been completed at the central station? Mr. Turner thought that with proper men employed in this branch the meters would be handled properly and be subject to no difficulties from jar in moving back to premises. The plan they followed was for the man placing it back in position to turn on a small load and see that everything was in order, and that no condition existed which would prevent its running nicely.

JOINT USE OF POLES.

Mr. D. L. Gaskill, of Greenfield, Ohio, in a paper entitled "Joint Use of Poles by Public Service Companies," pointed out that recent court decisions in Ohio in relation to the use of streets by public service companies and the growing sentiment in communities against disfiguring the streets by a multitude of pole lines, bring prominently before the managers of public service companies the subject of the paper. He recommended the appointment by the association of a committee to consider the question and formulate a plan for meeting it satisfactorily to the public service companies. He suggested that telephone companies should be required to use armored cable whenever other than a limited number of wires were installed on any one street, and that the distance between high-tension wires and the poles be specified, together with the distance between the cross arms of the respective companies. The insulation of high-tension wires should also be given consideration and the different companies occupying the same poles should have their rights and duties clearly defined by uniform agreement.

After a discussion of some of the points contained in it in executive session, the recommendation to appoint a special committee was concurred in.

After hearing in executive session reports of officers and special committees, the convention went into election of officers, resulting as follows: President, M. E. Turner, Cleveland, Ohio; vice-president, F. E. Valentine, Piqua, Ohio; secretary-treasurer, D. L. Gaskill, Greenville, Ohio. Advisory Committee—D. L. Gaskill, Greenville; Samuel Scovil, Cleveland; E. J. Bechtel, Toledo. Executive Committee—J. H. Perkins, Youngstown; C. M. Hart, Sandusky; J. F. Bendure, Lima; M. C. Hull, Columbus; W. E. Miller, Mt. Gilead. Finance Committee—C. E. Inman, Warren; N. Way, Lisbon; W. P. Engel, Defiance.

In his speech of acceptance, President-elect Turner, after thanking the members for the unexpected compliment paid him, adverted to the valuable work done by the retiring president, and by Secretary Gaskill, in whose capable hands most of the detail work of the association must necessarily remain. He congratulated the members upon the evident increase in membership and interest from year to

year, and attributed to Mr. Perkins great credit for the way in which he had presided over the present meeting.

Mr. Perkins acknowledged the compliment, and regretted that, owing to illness in Mr. Gaskill's family, that gentleman, after carrying throughout the year most earnest work in building up and looking after the interests of the organization, had unfortunately been unable to attend the meeting in person. A special vote of thanks was given to ex-President Perkins and to Secretary Gaskill, the former on motion of Mr. Valentine, the latter on motion of Mr. McKnight.

On motion also of Mr. McKnight resolutions of thanks were offered to the following: The Warren Electric Manufacturing Company, the Sandusky Gas & Electric Company, Mr. C. M. Hart, manager, and to the Ladies' Entertainment Committee, Mrs. H. B. Warren, Mrs. W. Beupel, Miss Bernice Warren and Miss Lenhart; also to the technical and daily press.

EXHIBITION NOTES.

The Warren Electric Manufacturing Company, through their representative, Mr. Muir, and others of their force, contributed greatly to the social pleasures of the meeting. The first thing that happened to every fresh arrival after registration was a trip to the hatter's, where a cap of special design was furnished to measure, and these white caps tended greatly to fraternize and give to the visitors a certain esprit du corps. Tuesday evening the Warren Company took the convention to Cedar Point, and made up a theatre party there.

The Ladies' Entertainment Committee escorted the visiting ladies to the Soldiers' Home by trolley, also to Ruggles Grove, where they were guests of the Lake Shore Electric Railway Company.

The actual exhibits at the convention were few in number, but were of a high grade and ahead of any previous year's.

The Westinghouse Company, who sent the largest number of representatives, also had a very choice display, including a fine line of instruments of precision, and also arc lamps. They showed downstairs in the lobby a constant-current regulator for alternating-current series lamps. Their other exhibits were too numerous to permit of detailed mention.

The Nernst Lamp Company lighted the hotel lobby with their lamp, and also showed upstairs their lights under wattmeter test, and also lighting colors illustrating the approach of the illumination to daylight effects.

The General Electric Company, in the parlor adjoining the convention room, made an elaborate display, showing their new mercury orthochrome lamp, which contains a mercury lamp and six incandescents, which furnish the red rays lacking in the plain mercury type; also new monochrome type mercury tube with holophane enclosing globe, to secure distribution; also mill type of same for lighting factories, draughting rooms, etc., where a steady light is desired, and one easy on the eyes. The mercury lamps were run from a mercury rectifier rectifying 330 volts to a direct current of 125 volts suitable for running the lamps. The luminous arc received many favorable comments. A new candy-making machine shown in this room and presided over by Mr. Goodwyn, kept that accommodating gentleman busy handing ladies and gentlemen the delicate filaments of sweet stuff hot from the wire.

The Wagner Electric Manufacturing Company exhibited its motor, transformer, switchboard type of ammeter and portable ammeter, the latter of new design.

The Duncan Electrical Manufacturing Company showed their wattmeter of late design with visual bearings and compensating device.

Lectures at the New York Trade Schools.

Following the usual custom, a series of evening lectures on steam and electrical engineering will be given during the coming fall and winter at the New York Trade School, First Avenue, Sixty-seventh and Sixty-eighth Streets. These lectures are intended for practical workers in the profession. They present an attempt to fulfill a long-felt want for practical information and explanation of phenomena and experience of daily occurrence.

The lectures take more of the nature of a conversation between the lecturer and his hearers, and questions are freely asked and explantations given accompanied by illustration and experiments.

The main object of this course is to present in a simple and easy way to men of practical experience the reasons for the laws upon which their trade is based, and explanations of the phenomena that have led to the formulation of these laws. It is believed that in this way only can a man learn to do effective work, as a workman, knowing only the rule of thumb, necessarily labors under a disadvantage.

The cost of attending each of the courses on steam and electricity is one dollar. Information as to dates and arrangements can be had upon application to H. V. Brill, superintendent, New York Trade School, Sixty-seventh Street and First Avenue, New York City.

Parsons on Patent Law Reform.

Advices from England state that the Hon. Charles Algernon Parsons, the English inventor, who developed the steam turbine, made an interesting address at Cambridge on August 18, before the Engineering Section of the British Association on the subject of inventions and patents. Premier Balfour, the President of the Association this year, attended the meeting of the Engineering Section, and, on behalf of the Associated German Engineers, he presented a gold medal to Mr. Parsons, the president of the Section, in recognition of his merits as an inventor.

Mr. Parsons, in his address, urged that greater encouragement, assistance and protection be given to the British inventor and patentee along the lines adopted by Germany and the United States. He strongly advocated changes in the patent laws of all countries, especially in regard to an extension of the time limit; but he pointed out that it would be useless for Great Britain alone to make these changes if capitalists were to be induced to invest money in the development of great undertakings dependent upon patents from which the world would reap immense benefit.

As an illustration Mr. Parsons gave details of a scheme for the sinking of a shaft to a great distance in order to explore the lower depths of the earth. He submitted estimates of the cost and the time of sinking a shaft from two to twelve miles. To sink the shaft to the latter depth, he said, would cost £5,000,000, and take eighty-five years. If such an undertaking depended upon a patent it would, under the present laws, be impossible to secure the necessary capital.

Mr. Parsons suggested as a solution of the problem the placing of the question of life patents under the control of a central international committee, which would apportion the life privileges, thus insuring the prolongation of patents and making them of international application. He advocated the grant of a fair monopoly to those who pledged themselves to spend a minimum sum within a stated period in research in order that they might reap a reasonable return.

A New French Automobile.

Mr. Thornwell Haynes, United States Consul at Rouen, France, sends the following:

"The trials which were made recently at Longchamps with a new electric carriage constructed by the Electromotion Company, whose headquarters are in the Avenue Montaigne, give every promise of creating a revolution in the automobile world. Like all the firms which are interested in the construction of electric carriages, the Société Electromotion has, up to the present, employed for the transmission of power to the wheels motors of high speed, with 800 to 1,000 r.p.m., these acting with the intermediary of chains and pinions or pinions and gearing. The new method is simple. The motors and the wheels are one and the same thing, working together, running at the same speed and without any kind of intermediary. The "live axles" can be placed in front or behind. They receive their motive power direct from the accumulators, and the chains, pinions and gearings are things of the past. A carriage with live axles can travel 20 to 30 per cent. farther than the ordinary carriage, for the reason that it is relieved from lost energy and has no impediments. In a word, weight is reduced, power increased, heating diminished and absolute silence obtained, while wear and tear are brought to a minimum.

"In the trial the new system, although primitively mounted, worked admirably at five speeds, varying between 4½ and 19 miles an hour, and with perfect silence. There was no jar in starting or in changing speed. The general appearance of the carriage is improved, as the motor being removed from under the vehicle the body can be built low."

Electric traction motors of this general type are a familiar and old device in the United States.

CURRENT NEWS AND NOTES.

VENEZUELA'S NEW TELEGRAPH TARIFF.—The new Venezuelan telegraph tariff provides for a charge of 29 cents for dispatches of from one to ten words—double price from 6 p.m. to 6 a.m. The usual language is Spanish, but any other language may be used at double rates.

NAVY CONTROL OF WIRELESS.—A dispatch from Washington states that Secretary Taft has disapproved the recommendation of the joint Army and Navy Board and the suggestion of Secretary Wilson that the Navy be given full control of all wireless telegraph stations in time of peace, so that it may be prepared to operate them in time of war. In a letter to the President, Mr. Taft expresses the opinion that it is only necessary that the joint board should keep a record of all wireless stations in time of peace, and that the Navy be given authority to assume control of them in time of war.

ALASKAN CABLE CELEBRATION.—The Seattle Chamber of Commerce is planning a public banquet in October to celebrate the success of the United States Signal Service in Alaska, and the completion of the cable to the United States. Efforts will be made to induce General Greely, chief of the signal service, to be present, and invitations will be sent to President Roosevelt, Secretary of War Taft and ex-Secretary of War Root. The cable already completed extends from Seattle up the coast to Skagway, at the head of Lynn Canal. It is supposed that this part of the world will also give ample scope for wireless telegraphy.

CONSTANT-SPEED INDUCTION MOTOR.—The current in the secondary of an induction motor has a frequency corresponding to the slip of the rotor from synchronism. If current of a certain frequency be supplied to the secondary, the rotor will travel at the speed determined by the corresponding slip. Mr. William Stanley, in a patent issued August 16, discloses a method of producing the current to be supplied to the secondary, by the use of a local auxiliary exciter, which can be connected to or disconnected from the induced circuit. Such a motor equipment runs at a speed determined by the difference between the main circuit frequency and the frequency of the auxiliary exciter and operates synchronously at this speed.

SUBMARINE SIGNALING.—The Canadian Government, by an order adopted in council at Ottawa, will enter into an agreement with the Submarine Signal Company, of Boston, for the installation of thirty bells in the St. Lawrence River and off the coast of the Maritime Provinces. Of the thirty stations to be established, twenty-six are to be operated from the shore and four from lightships. It is expected that all ships making Canadian ports will be equipped with the telephonic apparatus for picking up the sounds of the bells. Already provisional arrangements have been made with the principal steamship companies of the Dominion for the installation of the apparatus. The system, on which the late Dr. Elisha Gray worked, has been described in these pages.

REGISTERING SHIP'S COMPASS INDICATIONS.—Mr. W. Whiteman has recently invented an arrangement for registering the indications of a ship's compass in the form of a continuous curve. The compass has 360 contacts, one for each degree, and is connected by nine wires with a registering device. The latter contains a clockwork which draws a strip of paper forward every second by 1 mm. This strip of paper is ruled with 360 lines, corresponding to the 360° of the compass, and a pen always indicates on the paper strip the degree at which the needle of the compass is at that moment. If, for instance, a ship sails on a course of 70° and this is changed, temporarily or permanently, to 75°, the registering apparatus will plot the change and indicate the time when it was made.

CONVENTION TRAIN.—As the National Electric Light Association will not hold a convention at St. Louis, Mo., during the Exposition, but will participate in the Congress, Mr. Alex Henderson, master of transportation of the National Contractors' Association, has made arrangements for the transportation of members who desire to attend the sessions of the International Electrical Congress, which convenes on the morning of September 12, on the Contractors' special train of best Pullman equipment. Members and their friends who desire accommodation on this train should at once make application to Mr. Henderson, 527 West Thirty-fourth Street, or Mr. M. C. Roach, general Eastern passenger agent, 1216 Broadway, New York City. The train leaves the New York Central depot at 1 p.m., September 10.

TELEPHONY ACROSS THE CONTINENT.—If reports in the San Francisco *Chronicle* are to be believed, the Huntington syndicate of California, which has acquired several hundred miles of long-distance telephone lines in Texas, is rapidly carrying out plans for a through long-distance telephone line between the Atlantic and Pacific coasts. The southern route will be followed. The acquired lines in Louisiana and Texas and the existing lines in California leave a gap of 600 miles in Texas, between San Antonio and El Paso, and all of New Mexico and Arizona to be filled in. The syndicate is engaged in negotiations for the purchase of independent long-distance lines through Arizona and New Mexico, and when this is done about 800 miles of wire will have to be put up for a connection between Los Angeles and New Orleans. Connecting lines will be built northward all along the main system.

CONTROL OF REPULSION MOTORS.—A patent issued August 16, 1904, to Maurice Milch relates to a method of controlling single-phase commutator motors of the repulsion type and has for its object to obtain this control without at any time opening the circuit, and simply by varying the relative connections in such a way that each connection as it is broken is carrying little or no current; also to provide a method whereby a smooth acceleration of the motors from rest to full speed may be obtained with the use of no external resistance or voltage regulation. To accomplish this result the inventor arranges to use four repulsion motors and to connect the primary members of these machines in various series, series-multiple and multiple relations, having the secondary members at all times connected in a locally closed series circuit. In changing the primary of one motor from the series to the multiple connection, both the primary coil and the secondary coil are locally short-circuited so as momentarily to render them inactive.

EXECUTION BY ELECTRICITY.—On account of the fact that numerous instances can be cited where it has been found necessary to subject criminals to repeated shocks before they could be pronounced dead, Frederic R. Marvin in a letter to the *Medical Record*, has been led to suggest the question, Are we entirely sure that the person in the chair is killed by electricity? There are those who think that the so-called post-mortem is in most cases ante-mortem, and that the knife and not the electric current does the work. It is believed by some that a considerable number of those who have been sent to the chair could have been resuscitated after they had been pronounced dead, and up to the time of the so-called autopsy. The writer thinks that the four pre-requisites for a successful execution—certainty in result, celerity in action, painlessness in the endurance and the maintenance of a decorous solemnity—could best be obtained by substituting for electricity some chemical agent, either gas or liquid, to be given by hypodermic injection if other methods should be found inadequate.

TROLLEY SUNDAY EXCURSIONS.—It would appear that the trolley is serving as one means of preventing steam railroads from breaking the Sabbath. In commenting on the recent action of the Lake Erie & Western Railroad in abolishing Sunday excursions, Vice-President Brown, of the Vanderbilt lines, says: "I have always held that a railroad company has no right to take hundreds of the scum from a big city and dump them at the front doors of residents in the small towns, thus spoiling the enjoyment of the Sabbath day. Neither does the railroad have the right to take hundreds of young couples away from the influences of the home and send them where the influences are anything but good. I am also opposed to the greed displayed when a railroad takes scores of wornout, weak, shell-like coaches and loads them from end to end, thereby subjecting many people to the dangers of a terrible wreck. I do not know, however, that these considerations would be powerful enough with the management of any railroad to stop Sunday excursions. Accordingly, I am glad that trolley line competition has reduced the rates to a point where we can stop Sunday excursions on economical grounds."

MULTIPLE SECONDARY TRANSFORMERS.—In order to be able to supply both motors and lamps from a single transformer in such a way that motor load variations may not produce serious fluctuations of the voltage of the lamp circuit, J. S. Peck and C. L. Fortescue, according to a patent issued to them August 16, propose to provide a transformer with independent secondary windings for severally supplying independent loads. The windings are placed with reference to the primary winding and to each other so that the leakage magnetic field produced by a load upon one circuit will be productive of a minimum degree of disturbance upon the other. This is done by interlacing the coils and interconnecting them so that the secondary coils are symmetrically disposed with respect to each other and to the primary coils.

EARTH SHIELD FOR TRANSFORMERS.—Grounded sheets of metal are sometimes placed between adjacent coils belonging, respectively, to the primary and secondary windings of a transformer, so that in case of accidental injury to, or breakdown of, the insulation, the high-voltage current passes through the metallic shield to the ground, thus effectually protecting the low-voltage winding from the high-voltage current. When, however, such shields are employed in transformers of the shell type, considerable trouble is often experienced on account of the heating of these shields by local eddy currents generated therein. Mr. C. F. Scott, in a patent issued August 16, describes a method of overcoming this difficulty by splitting the shields in those places where the eddy currents are most likely to occur, or by providing a shield, the resistance of which is such as to prevent excessive currents.

GOVERNMENT TELEPHONE SYSTEM.—Consideration was given at the Cabinet meeting in Washington last week to the proposed establishment of an interdepartmental telephone system for the transaction of Government business in Washington. Under a recent decision of the courts, the Chesapeake & Potomac Telephone Company is proceeding to collect from the Government additional charges for the Government telephone service. Contracts have been presented to the Government by the company under which substantial advance in the rates heretofore paid is charged. This proposition does not meet the approval of the President and members of the Cabinet, and it has been suggested that the Government erect and operate a telephone system of its own among the various departments and the offices of the District of Columbia. After a thorough discussion of the subject, Secretary of the Navy Morton was delegated to make an investigation of the matter, and to report fully at a later time. It is realized, of course, that the establishment of such a system would necessitate Congressional action, but press dispatches allege that that may be secured without special difficulty on the statement of facts presented.

MECHANICAL RECTIFIER FOR ALTERNATING CURRENT.—When a mechanical rectifier is used with alternating current it is necessary that the brushes be shifted with relation to the commutator upon change of load in order to obtain a minimum amount of sparking. Mr. A. D. Lunt has patented a means for causing the rectifying commutator to be shifted backward or forward instead of shifting the brushes, which, instead of being moved, are maintained stationary. As is well known, the armature of a synchronous motor is shifted backward with respect to the alternating wave when the field strength of the motor is diminished, and pushed forward when the field strength is increased. Advantage is taken of this fact in adjusting the commutation of a rectifying device driven by the motor, the adjustment being secured by varying the field of the motor. In combination with a constant-current transformer the device may be used to counteract the effect of the lagging current taken by the transformer, by causing the field of the synchronous motor driving the rectifier to be in general overexcited and to increase or decrease in strength as the power factor of the constant-current transformer tends to decrease or increase, respectively, with change in load.

POWER FACTOR INDICATOR.—If, in an induction wattmeter, the current in the shunt coil be in time quadrature with the impressed e.m.f., only the power component of the current in the series coil will be effective in producing a rotating field at the moving disc, and thus in producing torque at the rotor. If, however, the current in the shunt coil be in time phase with the impressed e.m.f. only, the wattless component of the current in the series coil will produce torque. Upon these facts depends the construction of a power factor indicator patented by L. T. Robinson, August 16. The indicator consists of two separate induction wattmeters of special construction acting upon two discs, or sections of discs, mounted upon the same shaft. The shunt coil of one meter is supplied with current practically in time phase with the impressed e.m.f. on account of the high non-inductive resistance in the shunt circuit, while the high value of inductance in the shunt circuit to the other meter causes the current therein to flow practically in time quadrature to the impressed e.m.f. The torque due to one meter is opposite to that due to the other, so that by means of specially shaped discs the rotor is caused to assume a position depending upon the relative values of these torques and thus to indicate the circuit power factor upon a scale over which plays a pointer connected mechanically to the rotor.

REGENERATIVE TRACTION MOTORS.—Numerous attempts have been made to render available the energy stored in a moving train when being brought to rest or in descending grades, but difficulties have been encountered, chiefly on account of the fact that the type of machine best adapted for motor operation is poorly suited for generative purposes. Four patents issued August 9, 1904, to J. G. V. Lang, of London, England, have as their common object to enable the good features of the series motor to be retained for the duty of accelerating and running, and yet to have available the shunt characteristics which are essential for regenerative braking. The field coils of the motor are wound in sections which are connected in multiple under normal operating conditions, and are placed in series when the machine is to operate as a generator. For effecting this change from series to shunt, a special barrel type controller with suitable interlocking devices is employed. On account of the fact that the strength of the magnetic field of the motors decreases practically to zero at the moment of breaking the field circuit in changing from the series to the shunt condition, considerable shock is caused when the usual field change cylinder is employed, because of the rush of current through the motor armature under the weak counter e.m.f. The inventor provides means for avoiding this rush of current by retaining in the circuit of the series field windings a certain amount of series turns when the series winding is broken in changing from the series to the shunt condition. Since the field circuit is not completely broken, and the motors are, therefore, never electrically inactive, the sparking at the controller tips is minimized, thus availing of the good features of the "closed-circuit" control.

LETTERS TO THE EDITORS.

Three-Phase Traction in Italy.

To the Editors of Electrical World and Engineer:

SIRS:—Presuming that your readers take a special interest in practical results obtained in the electric trunk railway traction field, we beg to communicate to you the following data:

Some years ago we built an electric main railway on our traction system, employing high-tension, three-phase current, near Lake Como, between the towns of Lecco, Colico, Sondrio and Chiavenna. These lines form part of the railway network of the Società Italiana per le Strade ferrate Meridionali, Rete Adriatica. The installation of same, however, has been regarded as a big experiment, upon Ganz & Co.'s risk, the company in question having undertaken to take over the electric installation only if the traction system used and the whole installation during a period of two years should prove a thorough success and fulfill all the requirements of a regular railway service.

The guarantee in question began on the 15th of October, 1902, and would, therefore, expire on the 15th of October, 1904. The Italian Railway Company, which, during the period already expired, has had an opportunity of closely observing the merits of the system and the whole installation has decided to take over the whole plant on and from the 10th of July, 1904, although according to the terms of the contract the guarantee was to last a few months longer. The transfer of the plant actually took place on the day mentioned, and

the line of 106 km. length operated on the high-tension, three-phase system, therefore, is now permanently annexed to the regularly worked net of the Rete Adriatica.

BUDAPEST, HUNGARY. GANZ & CO.

[Details of this work have been given fully in the pages of this journal from time to time.—EDS. E. W. AND E.]

Testing Induction Motors.

To the Editors of Electrical World and Engineer:

SIRS:—I have been particularly interested in Mr. E. Alexanderson's article relative to testing induction motors. The method proposed is strikingly novel and very useful. I note the method used for measuring the "slip," and think that possibly some of your readers may be interested to know that the slip can be very satisfactorily measured without the use of sectors operating at a speed near the line frequency. For the past three years it has been my practice to measure the "slip" by simply chalking a single mark on the end of the armature where it can be readily seen. When the motor is near synchronous speed, the chalk mark, viewed in the light of an arc lamp operated from the same line as the motor, appears to revolve backward at the speed of the slip. This speed, being low, can be taken with an ordinary, or stop, watch.

Though I have never used it, the same method might prove useful in small stations in getting alternators into synchronism (not phase), as it is very easy to tell whether a machine is revolving above or below synchronism.

BROOKLYN, N. Y. IRVING A. TAYLOR.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Zone Dynamos.—JOEL.—The first part of an illustrated description of a type of dynamos and motors called the "zone" type. The principal feature consists in the construction of the energizing field coils so that one coil only is required in place of two or more coils, and the design and disposition of that coil directly over the neutral zone of the armature and close to and either parallel with, or cutting at a slight angle the armature coils undergoing commutation. Fig. 1 is

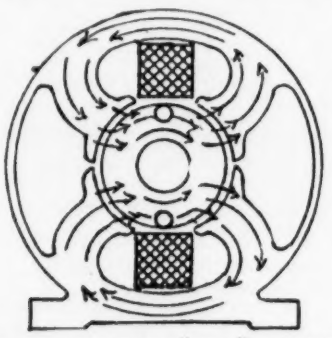


FIG. 1.—SECTION OF "ZONE" DYNAMO.

a diagram of the section of a bipolar "zone" dynamo in which the magnetic circuit is made as short as possible. The large upright limbs and yoke of the ordinary bipolar type are replaced by the circular cast case, and curved bifurcated poles without joints in the magnetic circuit; a single energizing coil is placed directly over the neutral zone of the armature, hence the name "zone." The coil in this position requires less ampere-turns owing to the saving of leakage than the two coils in older types, whilst the output from the armature is found to be greater, and the embracing arc of the poles can be increased, with a lessened reluctance in the air-gap, and a considerable reduction in the ampere-turns and saving in the I^2R loss. The whole machine is claimed to be smaller, lighter and more efficient. Of far greater importance, however, than even the saving of weight and cost of materials, is said to be the greater efficiency of the zone energizing coil. Various details are given of the construction of such machines.—Lond. *Elec. Rev.*, August 5.

REFERENCES.

Alternators.—TORDA.—A mathematical article in which he gives an outline of a general theory of the variation of the voltage at the terminals of an alternator with varying inductive load. On the basis of this theory he describes a method by which the voltage drop may be correctly determined from the no-load and short-circuit characteristic curves. Some results are given of an application of this method in practice.—*Elek. Zeit.*, August 4.

Armature Reaction.—HENDERSON AND NICHOLSON.—An article giving a comparison between the theoretical and experimental armature reaction of a 30-kw, three-phase alternator in a university laboratory in Glasgow. The alternator has revolving field poles and gives 50 periods per second at 750 r.p.m., the normal e.m.f. being 200 volts and the current per phase winding 87 amp. The agreement between theory and experiments is satisfactory.—Lond. *Elec.*, August 5.

LIGHTS AND LIGHTING.

Nernst Lamp.—A full account of the discussion which followed Salomon's recent paper on Nernst lamps of the Allgem. Elek. Ges., which was abstracted recently in the Digest. Some of the speakers gave results obtained with the Nernst lamp in practice. Gaisberg gave the results of longer tests of small lamps of about 16 candles, consuming 0.25 amp. at 110 volts, and others of 32 candles, consuming 0.5 amp., at 110 volts. About 25 hours after starting, the lamps had assumed a candle-power which remained nearly constant for about 300 hours with the smaller lamp and about 400 hours with the larger lamp. After that time the lamps are still nearly equal to 4-watt, carbon-filament lamps, and therefore give a very economical light. The candle-power decreases afterward more quickly and the consumer should be urged to exchange the lamps for new ones. Passavant stated that troubles were first experienced on account of breakages due to rough handling. The public could not understand that the Nernst lamp is more delicate than the ordinary incandescent lamp. He has made tests of Nernst lamps used for street lighting. He used 220-volt lamps for lighting various bridges and found that they did not burn out more often than ordinary incandescent lamps at 3.6 watts per candle. The lamps burn in the average more than 800 hours, but this is really a disadvantage, since after 800 hours the lamp has no longer the candle-power which it should have. The alternating-current lamps are not yet so far developed as the direct-current lamps. From the experience with 1,000 alternating-current lamps, he found an average life of 325 hours. The practice was to replace a lamp when it was burned out or after 500 hours. After that time the candle-power had decreased to ⅔ of the original value. May said that the public does not in general replace lamps often enough; it is good practice, at least for smaller central stations, to offer free exchange of lamps and to urge the public to replace the lamps as soon as they find that their lamps no longer give sufficient light. Teichmüller referred to a report of the Electrical Society of Switzerland. The results obtained there with the Nernst lamp were very variable. In some plants it was quite successful, while in others it was not successful at all. Salomon, in his reply, stated that the lamps used in these tests in Switzerland were of an older type. The good results were obtained in direct-current stations, while the bad results were obtained in alternating-current plants, in which there was a considerable variation of voltage. It does not seem that the filament itself is influenced adversely by increasing the number of connections or disconnections of the lamp to the circuit. On the other hand, the life of the heating device is greatly influenced thereby, although this is more a question of cost, since the life of the heating device will be the longer, the more platinum there is used. The Allgem. Elek. Ges. designs the lamps so that they may be lighted 800 to 1,000 times. They use not more than three filaments in a lamp, while in the United States lamps up to six filaments are used, but the speaker thinks that the use of more filaments in one lamp is of doubtful value for the reason that

with it the number of sources of error increase. The Allgem. Elek. Ges. endeavors to build filaments for higher current and has reached 1 amp. and hopes soon to reach 2 amp., while it is said that in the United States the practice is not to go above 0.4 or 0.5 amp.—*Elek. Zeit.*, August 4.

POWER.

Swiss Water Power.—A note stating that the arrangement of the water power station at Schaffhausen on the Rhine intends to increase the capacity of the plant by filling during the night-time a pond having a capacity of about 10,000,000 gallons with water from the Rhine. The pond is situated at a considerable height above the river and the pumps are to be actuated by synchronous motors, which, during the daytime, will be run as generators driven by turbines fed with water from the pond.—Lond. *Elec.*, August 5.

REFERENCES.

Heat Engines.—DESCHAMPS.—An article referring to the competition of internal combustion engines and steam turbines, with the old steam engine. It is remarked that the steam turbine may again find a competitor in the gas turbine, and that a turbine of 500 hp is actually in course of construction. The author discusses theoretically the relative advantages and disadvantages of steam engines and gas engines and endeavors to show that while the efficiency of the gas engine is higher, yet each of these two kinds of prime-movers has a distinct superiority over the other in certain respects.—*L'Eclairage Elec.*, August 6.

Electric Power.—LONGBOTTOM.—The first part of a long abstract of a paper on the adaptability of electric driving. The author gives some tables showing the results of tests of mechanical distribution, efficiencies of combined high-speed steam engines and dynamos, efficiency of motors and efficiency tests of group driving.—Lond. *Elec. Rev.*, August 5.

Corrosion in Steam Boilers.—STANDAGE.—A discussion of the chemical and physical influences which tend to produce corrosion in steam boilers.—Lond. *Eng'ing Rev.*, August.

Boiler House Economics.—DOWNE.—His complete paper, together with a discussion in full, abstracts of which were recently noted in the Digest.—Lond. *Elec.*, August 5.

TRACTION.

Trieste.—SEEFEHLNER.—The first parts of a long and fully-illustrated description of the electric railroad from Trieste to Opcina. It has a total length of 5.2 km.; the first and the last parts of the line are adhesion roads, while in the central part, of 800 meters length, the cars are drawn by a rack locomotive. The construction of the latter is similar to that of the Jungfrau road, but it has only one gear wheel, which is driven by two motors; 2,000-volt, three-phase current is supplied from the central station of Trieste and changed to direct current in the converter station.—*Elek. Bahnen*, July, No. 14, and August, No. 15.

REFERENCES.

Surface-Contact System.—LETHEULE.—A long and profusely-illustrated description of the Dolter surface-contact system, which has already been noticed in the Digest.—*Elek. Bahnen*, July, No. 13.

Berlin.—MÖLLER.—An illustrated account of the main features of construction, equipment and operation of the electric elevated and underground railways of Berlin.—*Eng'ing Mag.*, August.

Industrial Locomotives.—GAIRNS.—A continuation of his illustrated serial on industrial locomotives for mining, factory and allied uses. In the present installment the author deals with compressed air and internal combustion locomotives.—*Cassier's Mag.*, August.

High-Speed Cars.—BUHLE AND PFITZNER.—An illustrated description of the high-speed railroad cars used on the Zossen experimental line.—*Dingler's Pol. Jour.*, July 16 and 30.

High-Speed Traction on Main Lines.—BORRIES.—The first part of a paper in which the author first summarizes the results obtained with high-speed electric traction and then begins to discuss the behavior of steam locomotives at a high speed.—*Elek. Bahnen*, July, No. 14.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

South Africa.—ROBERTS.—An article on electrical engineering in South Africa. While in England gas light is a most formidable rival of electric light, in new countries electricity easily outdistances gas both in cost and efficiency, and the reason is that the former can be so much more easily and cheaply distributed by the use of overhead mains throughout the great areas which usually obtain in colonial towns. In addition, the cost of production of current may generally be taken at not more than twice English figures, but gas cannot be manufactured at less than three to five times English cost. Owing also to the fact that coal is somewhat poor and bi-products cannot be disposed of at payable prices, its quality is by no means good. The problem before municipalities in South Africa is to supply electricity as a necessary to life. With the exception of the Victoria Falls of the Zambesi River, no water power is available in South Africa, and dynamos are, therefore, generally driven by steam engines. The author believes that for large plants the water tube boiler is the best, except perhaps on the gold fields, where water is bad; if, however, proper water softening and purifying plants are put down, this difficulty will probably be eliminated and the water tube boiler will have a great and successful career before it in the Transvaal. Should oil ever be imported in bulk at low prices, the oil engine should do well. The installation of steam turbines is being considered, but the author thinks they will never be very successful in South Africa on account of the water difficulty, and that it will be too expensive to produce a high vacuum. He thinks prospects are good for the gas engine. The consulting engineers to the Johannesburg municipality have chosen gas engines for their new electric station, and their example will be followed if their experiment is successful. He then discusses condensing apparatus and states that very good results were obtained in the old station of the Durban corporation by using sewage for condensing purposes. For the past six years sewage has been pumped through ejector condensers and engines aggregating 700 hp have relied on this means for a vacuum. Solid matter gives no trouble, as it is all broken up in the centrifugal pumps. The vacuum was not very high, but would have been all right if an air pump had been added. The sewage became rather hot sometimes, but this was not important, as it was discharged directly into the sea. The result has been a great saving. The author remarks that the old station was a combined electric lighting and sewage pumping works. Concerning the method of distribution, small plants of not more than 200 kw in three generating units, generally supply a three-wire, 440 or 480-volt network. For larger areas polyphase systems are preferred, and the author favors two-phase. He then discusses the system of mains and the methods of charging and account keeping.—Lond. *Elec.*, July 29.

Johannesburg.—An illustrated description of motor-generators for the Johannesburg electric works, which, beyond supplying current for the lighting of a wide area, have also to supply power for the tramways, which, when completed, will have a length of about 52 miles. For this purpose two 250-kw synchronous motor-generators are provided.—Lond. *Elec. Eng'ing*, July 29.

Ipswich.—An illustrated description of the lighting and traction plant of Ipswich. It is worked in connection with a refuse destructor of Meldrum's simplex type, designed to burn 40 tons per 24 hours, and combined with a Lancashire boiler, 8 ft. in diameter and 30 ft. long, constructed for a working pressure of 200 pounds per sq. in. The guarantee for the combined plant was 1 pound of refuse to evaporate 1 pound of water of 60° F. into steam at 200 pounds pressure. The electric power house contains three 360-hp and two 200-hp steam-driven, direct-current machines. They are eight-polar, compound-wound, in the case of the larger lighting and fraction sets, and shunt-wound for the smaller sets, which are intended for lighting only. Their outputs and speeds are, respectively, 240 kw at 350 revolutions and 120 kw at 450 revolutions.—Lond. *Elec. Rev.*, August 5.

REFERENCE.

Voltage Regulation in Alternating-Current Systems.—MEYER.—The first parts of his fully-illustrated paper on this subject, an abstract of which was already noticed in the Digest. In the present installments the author discusses, first, the inherent regulation of generators under the following headings: Method of specifying regulation; influence of the regulation on the design of alternators; influence of regulation on efficiency and operation; regulation for constant power or current; regulation on unbalanced circuits. He then goes over to the discussion of the influence of voltage regulation on the system; he deals with incandescent lighting, induction motors and synchronous motors.—Lond. *Eng'ing*, July 22, August 12.

Electro-Physics and Magnetism.

Magnetization of Iron in Bulk.—Thornton.—An abstract of a Physical Society paper, in which he first describes a method of measuring large quantities of magnetism by the use of an exploring coil placed around the core and an exciting coil in series with a recording millivoltmeter. This was applied to determine the complete loops of magnetization for two rings of cast steel and cast iron, weighing respectively 3 and 6 cwt. The results were checked by a quantometer. The second section of the paper deals with the curves of rise of magnetizing currents, when the core is solid and when laminated, as affected by the reaction of the core currents, and also by the change of permeability during magnetization. A second simple method is given of measuring large quantities of magnetism in circuits having a large time constant, suitable for testing dynamo-electric machines. From two curves of rise, with the current in one reversed, expressions are given for finding the total induction in the core and its ratio to the residual magnetism. In the last section an example is given of the sudden dip in the curve of rise, observed only with large cores. The growth of current in a coil surrounding a solid circular core is calculated by Heaviside's formula, assuming constant permeability. No dip is found in the calculated curve, and it is, therefore, caused by a brief magnetic impulse which corresponds to the slip of the molecules at saturation seen in Ewing's model of the magnetization of iron. Photographs were given showing the direction of flow of eddy currents in cores of rectangular section of proportions 1:1, 1.5:1 and 2:1. In the discussion, S. P. Thompson, referring to the curves showing the rise of the magnetizing current, said he was not inclined to think that the effect was due to internal eddy currents in the core. Pretty said that the curves shown by the author suggest the possibility of detecting cavities in steel castings, as such castings would doubtless give curves differing from those representing a truly solid block of the same material, cast at the same time, and subjected to the same after treatment. It would be interesting to have a series of tests on the same block of steel, say, in which each process in the manufacture is represented, i. e., as cast after annealing, and after the surface scale or skin has been removed to various depths; also after the block has been cut up into slabs or laminæ and put together again.—Lond. *Elec. Rev.*, July 29.

Conduction of Electricity Through High Vacua.—Strutt.—A note on the conduction of electricity through high vacua, under the influence of radioactive substances. It is a matter of no great difficulty to detect the negative charge carried by the β-rays of radium. All attempts to observe directly the positive charge carried by the α-rays, however, have hitherto been unsuccessful. The author has made some experiments which show that even in high vacua there is a loss of electricity from a charged body in presence of the α-rays, independently of traces of residual gas. This effect necessarily defeats any attempt to detect the charge of the α-rays. The leakage at the very highest vacua was of about the magnitude which would correspond to ¼ mm. pressure if the law of proportionality, which holds good at higher pressures, were applicable to low ones. This leak was the same whether the charge was positive or negative. It is certain, therefore, that the current carried by the α-rays must be small in comparison with it. The leak which occurs in high vacua must be quite distinct from the ordinary leak, due to ionization of the gas; for the latter, at a pressure as low as that used in his experiments, would be at least 100 times smaller. It is very repugnant to believe that the curve in high vacua is carried independently of moving ions; as these cannot be derived from the gas, the only alternative seems to be that they are derived from the material of the radioactive substance, being torn away from it by the issuing α particle.—*Phil. Mag.*, August.

References.

Magnetic Permeability of Nickel and Iron.—Harrison.—An account of extended researches on the variation with temperature of the magnetic permeability of nickel and iron and its relation to other physical properties. For both nickel and iron there is a very good agreement between the "magnetic critical interval" (which is the range of temperature extending from the sudden drop in magnetic intensity to its vanishing point) and the range of temperature within which thermoelectric and resistance changes take place.—*Phil. Mag.*, August.

Coherence and Re-coherence.—Shaw and Garrett.—An account of a series of experiments. The authors believe that coherence can be best explained by the fusion theory. Re-coherence is due to residual coherence, the clinging of the surfaces being apparently an adhesion of the particles. It is hard to see how re-coherence can be explained, except by some change in or orientation of surface particles occurring in the violent commotion of coherence.—*Phil. Mag.*, August.

Electro-Chemistry and Batteries.

Electrometallurgy of Iron and Steel.—Bennie.—A paper in which the author first classifies the various purposes to which the electric furnace has been applied in the iron and steel industries, and then describes different types of furnaces. Some special data are given on the processes of Strassano, Harmet and Girot. The latter uses a furnace which consists of a crucible made of refractory material, surrounded by a resistance of graphite in granular form, or even glomerated. The carbon electrodes are placed equidistant around the resistance material surrounding the crucible; between the carbon electrodes refractory bricks are fitted. The whole is mounted on trunnions, so that it can be tilted even while running. Very uniform heating may thus be obtained, and the temperature can be maintained at 500° C. if desired, but can also be raised to 3,500° or 4,000° C. The author thinks that the following arrangement would represent the high-water mark in the utilization of the heat energy of coal in the iron and steel industries: the combination of the blast furnace for cast iron, the Bessemer converter for common steel and the electric refining furnace, using energy generated from waste blast furnace gases for making higher grade steels. The author finally describes the application of the electric furnace to foundry practice for refining purposes. He places an electric furnace in form of a ladle on a carriage, so that it may receive a charge from any of a number of cupolas, and may then be moved under the arrangement for carrying the electrodes. Without using excessive currents, liquid iron may be converted into steel of good quality. Electric power, if used during periods of light load of the central station, could be bought at a relatively very low rate.—*Electrochemical Ind.*, August.

Mercury Cathode Process.—Ketternbeil and Carrier.—An account of experiments on a process of Gurwitsch, who uses as mercury cathode for electrolysis of sodium chloride a plate of the following construction. An iron plate is placed vertically or inclined and a fine stream of mercury is sent from an orifice against the iron plate, where it spreads out to a very broad strip and flows downward. This strip would be contracted during the passage of the current on account of a change of the capillary constant, but this narrowing of the mercury strip is prevented by corrugating the surface of the iron plate. The intention of the whole arrangement is to use as small a quantity of mercury in the process as possible. The authors find that the process has the disadvantage that the efficiency is very low if no diaphragm is used. On the other hand, with a diaphragm the e.m.f. is high and the apparatus becomes complicated.—*Zeit. f. Elektrochemie*, August 5.

Measuring Conductivity of Electrolytes.—Addicks.—A description of a convenient method of making rapid tests of the conductivity of electrolytes. He used the method for testing copper electrolytes as employed in copper refining. The Kohlrausch method proved rather tedious and Hering's potentiometer was tried with considerable success. There was difficulty, however, in getting a non-conducting cell of the shape required at a reasonable cost that would stand higher temperatures without cracking, and the sliding electrode was difficult to keep in good condition in the presence of the corrosive liquid, while the expansion of the liquid in the open cell had to be reckoned with in the temperature coefficient runs. He found that a method was most convenient in which the solution is treated as though one had an ordinary metallic wire to measure, while at the same time the dimensions of the apparatus are chosen in such a way that the errors introduced are negligible. His method is an adaptation of the Munich shunt method for measuring currents in solid conductors. When the dimensions are properly worked out, the results agree closely with those found by the other methods. He gives the exact dimensions and connections of a cheap test tube used for this method.—*Electrochem. Ind.*, August.

Theory of Solutions.—Traube.—A paper in which he first sums up the various objections which have been raised against the theory of electrolytic dissociation. He proposes another theory which he thinks explains the facts better than the electrolytic dissociation theory. He assumes not only dissociation, but also association. He

believes that even in the most dilute solutions, in one moment every dissociation, for instance, of a molecule NaCl, is followed by an association of Na and Cl. There would be a chain of dissociations and associations, and not merely series of dissociations. Arrhenius' coefficient of dissociation is given by the relation of the number of particles of the electrolyte which are coined with two, three, etc., single molecules of the solvent and the number of its particles, which are joined with one molecule of the solvent or none.—*Phil. Mag.*, August.

REFERENCES.

Electroplating.—PFANHAUSER.—An illustrated description of improvements made in recent years in electroplating establishments. The author discusses especially zinc and nickel plating.—*Metallurgie*, August 8.

Storage Battery.—HILDEBRAND.—Historical notes on the development of the storage battery.—*Elektrochem. Zeit.*, August.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Legalization of the Standard of E.M.F.—An official communication from the Reichsanstalt with respect to the proposition of Carhart (supported by the American Institute of Electrical Engineers) to adopt the Weston cadmium cell as legal standard of e.m.f. A long review is given of the various resolutions adopted at international congresses concerning the units of resistance, current and e.m.f., and of the legislation which followed in various countries. In Germany the laws defining the ohm and ampere are in conformity with the resolutions of the Chicago Congress, but the volt is defined from the ohm and ampere by Ohm's law. Special laws have been issued in Germany concerning the use of standard cells. It is stated that Germany did not adopt the Chicago definition of the volt on the basis of the Clark cell, since the Reischsanstalt had already recognized the superiority of the Weston cell, and for the fundamental reason that they did not want to define three units which are not independent from each other. In those countries in which the Chicago figure for the e.m.f. of the Clark cell was legalized, the following difficulties have developed: The value adopted in Chicago for the Clark cell (1.434 volts at 15° C.) has meanwhile been found to be too high by about 0.001 volt; since the former figure was fixed by law, and since Ohm's law is valid in spite of any legislation, there are now in these countries two legal values for one volt, differing by about 0.1 per cent. The proposition of the American Institute intends to meet these difficulties by substituting for the old figure of the Clark cell a better figure for the Weston cell. This is thought by the Reichsanstalt to represent only a gradual improvement, and it is possible that in future similar discrepancies may arise again. "If one has gone so far to define the practical ohm not only by volume, but by mass and length of the column of mercury, in order to avoid any ambiguity in the law, due to the fact that the ratio between kilogram and liter is known only to a certain (although very high) degree to approximation, it would be wrong now to produce a much greater uncertainty by defining practically three units which are not independent from each other." In view of this fundamental principle, the proposition to legalize the Weston cell would necessitate that the definition of the silver voltameter be dropped and that the unit of current be defined by Ohm's law from the units of resistance and e.m.f. While it is true that measurements with resistance and standard cell are much simpler, quicker and easier than with the silver voltameter, yet the latter seems to be still better adapted as a primary standard. If certain fixed experimental conditions are maintained in the use of the silver voltameter, the results agree among themselves better than the results obtained with standard cells made at different times, though the greatest care may be taken in the latter case to use pure materials. The main disadvantage of the Clark and Weston cells is due to the behavior of mercurous sulphate made by different methods. In the explanation of these difficulties "a definite decision has not yet been reached." (It is stated that the Reischsanstalt, the National Physical Laboratory in London, and the Bureau of Standards in Washington are now investigating this point; but the recent papers by Carhart and by Wolff on the electrolytic preparation of mercurous sulphate are not mentioned at all.) Moreover, there are two forms of Weston cell, the one which has been adopted by the Reichsanstalt, containing solid cadmium sulphate crystals in excess, while the other is the type of the Weston Company, with cadmium sulphate solution saturated at about 4° C., without solid crystals. Moreover, the question of the most reliable external form of standard cells has not yet been definitely settled. Under these circumstances it is thought that those countries which have only recently legalized the ohm and ampere, cannot be expected to change these laws now. Before this can be done various absolute determinations of the e.m.f. of the Weston cell should give values of e.m.f. agreeing among themselves with such exactness that it would be reasonable to expect that the laws will not have to be changed for a long time. It is doubtful whether a congress held at a World's Fair is the proper place for definitely settling such important and difficult problems. It is urged that the Government bureaus in the various countries should endeavor to keep in touch with each other and should try to reach an agreement among themselves. An agreement reached in this way could be sanctioned afterward by an International Congress.—*Elek. Zeit.*, August 4.

Reichsanstalt.—A long review of the work of the Reichsanstalt in 1903. From the work on electrical subjects, the following results should be interesting. The cathode destruction under glow discharge (Holborn, Austin) is with disc cathodes 1 cm. in diameter, whose upper surfaces are covered with mica, proportional to the potential difference, and also to the chemical equivalent, i. e., the atomic weight divided by the valency. As regards the chemical equivalent, platinum, iridium, copper, nickel form one group, palladium, rhodium, bismuth and antimony another group, with a slightly different constant; silver may belong to either group; gold belongs to the first for pressures up to 1,000 volts; in aluminum and iron the loss of weight—which, of course, depends upon the arrangement of the apparatus—is very small. These experiments were made in air; in hydrogen atmospheres the phenomena are less regular. (The full paper by Holborn and Austin on cathode disintegration in the discharge through gases at low pressure is published in *Phil. Mag.*, August.) The detailed account of the experiments on the evaporation of electrically-heated metals and their re-crystallization (Holborn, Austin) has appeared. Strips 5 mm. in width, 0.1 or 0.2 mm. in thickness, were heated in atmospheres of air, oxygen, nitrogen and hydrogen. Iridium (and some of its alloys) evaporates most of the platinum metals in spite of its very high melting point; the loss is, as a rule, less in rarefied atmospheres, but palladium evaporates more when the pressure is reduced; in hydrogen atmospheres iridium and platinum evaporate very little; palladium cannot be tested in hydrogen atmospheres, as it alloys with hydrogen. The exact determinations of the electrical conductivities of aqueous solutions (Kohlrausch, Grueneisen), at moderate and very high dilutions, has been extended to salts of bivalent metals. Pure water, radiated upon through a glass wall by radium salt, increased its conductivity in two days at a rate as though in the same quantity of water, 25 cu. cm., 1 mg. of salt were slowly dissolved within a period of ten or twenty years. The standard resistances of manganin and mercury have for six years kept steady within 1 in 200,000. Fourteen tubular Kundt resistances, making up 1,000,000 ohms, are now at the St. Louis Exhibition. A new portable torsion galvanometer (Kohlrausch, Henning, Holborn) is not affected by the tramway currents of Charlottenburg, which deflect a freely suspended needle by 4 minutes of arc, and it remained quite steady also in the Reichstag building, where the disturbances amount to 8 minutes; but in the Physical Institute, where deflections of half a degree are observed, the galvanometer was not quite constant. The optical method of measuring alternating currents (Orlich) has been found reliable for currents of 800 amp. maximum within 2 per mille. A piece of platinum foil is heated first by direct currents, and then by alternating currents, to the same degree of incandescence, determined with the aid of the Holborn-Kurlbaum optical pyrometer. If the losses by radiation and conduction are kept constant, the heat values should be the same. For currents up to 270 amp. strips of platinum foil, 80 mm. in length and 15 mm. in width, from 0.01 to 0.3 mm. in thickness, are used, fixed between copper jaws, through which water is circulating; the strips are bent a little near the ends for expansion. For stronger currents platinum tubes 12 mm. in diameter, from 0.1 to 0.2 mm. in wall thickness, are applied.—Lond. *Eng'ing*, August 5.

REFERENCES.

Testing.—WORKMAN.—A continuation of his illustrated serial on factory testing of electrical machinery. He discusses the method of loading the motor by a brake and discusses the determination of efficiency of a motor either from losses or from a brake test.—*Elec. Club Jour.*, August.

Measuring Conductivity of Electrolytes.—See abstract of paper of Addicks under "Electrochemistry."

Telegraphy, Telephony and Signals.

REFERENCES.

Wireless Telegraphy.—A long editorial calling attention to the importance of a bill recently introduced by the British Government and having for its object the State control of wireless telegraphy. A long memorandum by Lord Stanley has now been issued, setting forth the reasons of the bill. This memorandum is reprinted.—Lond. *Elec.*, August 5.

Wireless Telegraphy.—Seibt.—A mathematical paper on the relation between the direct coupling method and the method of inductive coupling in the transmitter system for wireless telegraphy.—*Phys. Zeit.*, August 1.

Telegraphone.—Gradenwitz.—An illustrated description of the principles of the Poulsen telegraphone and of the main types in which it is built.—Lond. *Eng'ing Rev.*, August.

Miscellaneous.

Electric Fatalities.—A statistical note on fatalities and damage caused by electricity in Switzerland during 1903. According to a communication from "L'Inspectorat des installations à courant fort de l'Association suisse des électriciens," 13 persons were killed by electricity last year, and property was damaged in eight cases. Of the 13 fatalities, 5 occurred to persons employed in connection with the generation and distribution of electricity, one to a fitter of an electric firm and 7 to persons not connected with the electrical industry. With regard to the last-named, it is mentioned that all the accidents except one were caused by gross negligence. In the case of the 5 accidents to the members of the staff of electricity undertakings, it appears that the victims themselves were also mostly to blame. All the fatalities were caused by alternating currents, the voltages of which were 130 in one case, 500 in another case and from 5,000 to 10,000 in nine cases. In two instances the exact pressure could not be ascertained. The victim who was killed by 130 volts was a mason. He was standing on a bed of concrete freshly laid on the first floor of a new building and still wet. He took hold of a bare conductor carrying 130 volts and was killed on the spot. It is stated that he was a healthy and robust man.—Lond. *Elec.*, August 5.

Protection of Iron by Zinc.—Cowper-Coles.—An illustrated description of a new process for the protection of iron and steel from corrosion by means of covering it with a thin layer of zinc. The first step in the process is to free the iron from scale and oxide by dipping it into acid solution or by sand blasting, etc. The articles are then placed in a closed iron receptacle charged with zinc dust, which is heated to a temperature of from 500° to 600° F. for a few hours and then allowed to cool. The drum is then opened and the iron articles removed, when they are found to be coated with a fine and homogeneous covering of zinc, the thickness depending on the temperature and the length of time. The low temperature required makes the process cheap as compared with the process of dipping in molten zinc, and has the additional advantage that it does not deteriorate iron or steel of small section to the same extent as hot galvanizing.—Lond. *Eng'ing Rev.*, August.

REFERENCES.

Manufacturing Plant.—The first part of a long and fully-illustrated description of the works of the General Electric Company at Schenectady.—Lond. *Eng'ing*, August 5.

Radioactivity.—An editorial on the paper of Mr. T. Tommasina recently read before the French Academy of Sciences, in which the author refers to his experiments on monopolar electric dispersion produced by a metal wire heated by the electric current.—*Sci. Am.*, August 20.

Increase of Telephone Stock.

The Citizen Telephone Company, of Columbus, Ohio, has filed a certificate increasing the capital stock of the company from $750,000 to $1,250,000. The new issue is to be 6 per cent. preferred stock, upon which dividends are to be paid semi-annually. It is also to be preferred in case of insolvency. John Joyce signed the certificate as president of the company and Edwin R. Sharp as secretary.

A Model of An Irrigation Plant.

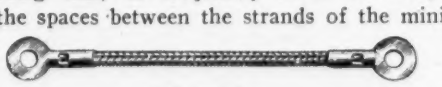
In connection with the Louisiana exhibit of the rice industry, Block 101, Agricultural Building, at the St. Louis Exposition, A. M. Lockett & Co., of New Orleans, have furnished the commissioners for Louisiana a model of a complete irrigation pumping plant, the original of which was installed for the Southwestern Rice & Canal Company, near Jennings, La. This model shows a Worthington conoidal pump direct-connected to a compound condensing engine, the steam being furnished by a duplicate set of water tube boilers and the exhaust being condensed by a Worthington jet condenser. The feed water for the boilers is pumped from an open heater by two Worthington boiler feed pumps of the duplex type.

The conoidal pump is especially designed for pumping large volumes against low heads. In general appearance it is somewhat different from the ordinary centrifugal pump, due partially to the widening of the pump chamber to admit a special form of impeller. The latter consists of a double, cone-shaped core, on which radial vanes are mounted. The shape of this core serves to modify gradually the direction of the incoming currents of water, thereby preventing sudden changes of velocity and direction which would absorb and waste power. The pump chamber, or shell, is divided into two equal parts by a radial diaphragm or partition extending entirely around the interior of the chamber and enclosing the base of the conoidal impeller. This partition prevents the impingement and consequent disturbance of the two entering columns of water. The conoidal pump is especially adapted to belt or electric motor driving. The space required in relation to the quantity of water delivered is about one-half of that needed by an ordinary centrifugal pump. The original of the pump shown in this exhibit was designed to deliver 30,000 gallons per minute, against a 20-ft. head, and pumps of this type can be used for heads up to 30 ft.

The jet condensing apparatus in this exhibit is of interest as showing the best form of condenser to be used where a natural supply of fresh water is to be had. The exhaust steam from the condenser pump is used in heating the feed water and thus returns to the boiler practically all the heat of the steam, so that the operation of the condenser outfit costs very little, while it adds considerably to the economy of the plant.

Terminals for Flexible Conductors.

All those who have attempted to solder suitable terminals to flexible conductors, such as lamp cords, will recall the unsatisfactory results obtained with the material ordinarily available for this purpose. The great difficulty in securing a solid joint is due to the method employed, which requires that the solder be depended upon for both mechanical strength and electrical continuity, the consequence being that, as frequently made or used, the solder which enters the spaces between the strands of the miniature cable



TERMINAL.

deprives the conductor of its flexibility up to a point at which the abrupt change in flexibility causes the individual strands to become severed with repeated movement of the conductor.

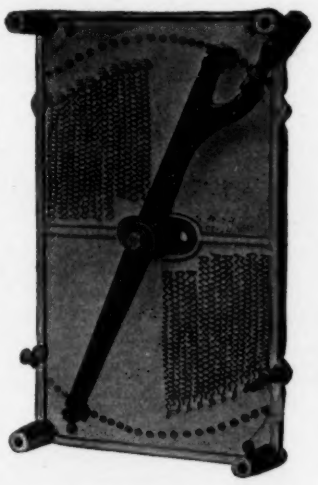
A type of connector which removes all difficulties in making a proper joint and yet retains the flexibility of the cable joined is shown in the accompanying cut. The terminal is punched from sheet copper and differs from other somewhat similar terminals in that a perfect mechanical joint is secured without the use of solder. This result is obtained by forming, during the process of stamping, a small sleeve within the cable portion of the terminal, into which sleeve a short length of the cable, previously having been laid bare, is threaded, and the fully-insulated section of the cable is then bent through 180° to its place, where it is securely held by the outer side leaves, which are squeezed to surround the cable. The joint is electrically completed by a drop of solder, which serves firmly to unite the terminal and the cable.

This device, which is being placed upon the market by W. H. Briggs, 4241 Bedford Avenue, Brooklyn, is adapted for all conditions requiring cable connections and is specially suitable for use with the flexible leads for measuring instruments and battery connectors in automobile equipments.

Sparkless Printing Press Controller.

The Ward Leonard Electric Company, of Bronxville, N. Y., has designed a printing press controller with special reference to the elimination of the injurious sparking upon the contacts. It is a well-known fact that no spark will be developed upon rheostat contacts, provided that the ohms of the step of resistance and the amperes which are passed through the step be kept sufficiently low, so that the corresponding e.m.f. developed at the contacts, upon inserting the step of resistance, is kept below the point at which an arc can be produced.

Field rheostats and theatre dimmers are familiar examples of sparkless rheostats. All sparking upon the contacts of this class of apparatus has been avoided by using such a large number of steps that the difference in potential between consecutive steps has been reduced to a point below which any sparking can occur. The resistance of these controllers is designed in two sections. The section first cut in circuit has capacity for the full torque current of the motor continuously applied. When this section is the only resistance in circuit, the motor will be running and developing countervolts. The insertion of all of this section of resistance will stop the motor under conditions of full torque, because the ohms are sufficient to cause the drop of the full line volts when the full torque current is passed through it. That is, by the time all the resistance of this first section is inserted in the circuit, under conditions of full torque, the motor will necessarily be at rest, since the entire e.m.f. will be dropped upon the resistance, and hence there will be no e.m.f. upon the armature terminals of the motor. At this stage begins the insertion of the resistance of the second section of the resistance. It will be evident that as each additional step of the resistance is inserted, when the motor is at rest, the current will be gradually reduced, just as in the case of a field rheostat or theatre dimmer. The purpose of this second section is to introduce into the circuit a sufficient amount of resistance to stop the motor, even if it be operating under conditions of merely friction load. The ampere capacity of the steps successively introduced in this second section is gradually tapered from the full torque current of the motor to the friction load current of the motor. The resistance of each successive step is such that the maximum current which can possibly be passed through it will not develop an e.m.f. between successive contacts sufficient to produce an arc.



PRINTING PRESS CONTROLLER.

Exhibits of The National Electric Company at St. Louis.

The National Electric Company, successor to the Christensen Engineering Company, Milwaukee, has, as already noted, an extensive exhibit at the Louisiana Purchase Exposition, showing to advantage its well-known Christensen air brake equipments and electrical machinery. Its space at Section 6, Electricity Building, a view of which is given in Fig. 1, is handsomely finished, and inviting to visitors. A large 400-kw, direct-current engine type generator is the largest unit shown at its space; a 150-kw, 500-volt, direct-current generator is driven by a 20-hp, 220-volt motor, and in addition to these there is in operation a 150-kw, 3,200-volt alternator, a 10-kw motor-generator set and a 60-kw, 500-volt, direct-current generator belted to a 30-hp, 220-volt motor. A three-car train showing the operation of the air brake control, such as is used by the South Side Elevated Railway, Chicago; the Boston Elevated, and the Intramural Railways is shown, together with a straight air brake equipment, used for the instruction of motormen by electric railway companies to explain in detail the operation of this brake. Three hundred cars at the Buffalo Exposition were equipped with Christensen air brakes, and all cars operating within the grounds of the St. Louis Fair are controlled by this type of brake. It is an interesting fact to note that 11,000 are used in America and more than 1,500 in Europe, Asia, South America, Africa and Australia.

Although comparatively young in the electrical field, the National Electric Company is turning out some large direct and alternating-current generators for lighting, power and railway service. The unit illustrated in Fig. 2 is of 1,500-kw capacity and is installed at Block 46, Machinery Building, Louisiana Purchase Exposition. It is driven at 83 r.p.m. by a 2,250 cross-compound engine, to which it is direct-connected, and delivers 6,600 volts at 25 cycles. The power generated is used for operating the large pumps, the immense streams from which flow over the Cascades, the largest artificial waterfalls in the world.

As will be seen from Fig. 2, the cast-iron housing is constructed with the view of furnishing ample ventilation without sacrifice of strength. The heavy frame is designed for maximum stiffness for the material used, and its rigidity obviates the necessity for external support. To facilitate erection, the frame separates in a horizontal plane, the halves being secured by means of keys and bolts, which are hidden from view within the frame, giving a neat appearance to the completed machine.

Special precautions have been taken to lessen eddy currents in the armature core by thoroughly annealing and japanning the laminated soft-steel punchings, while assurance that the core will not

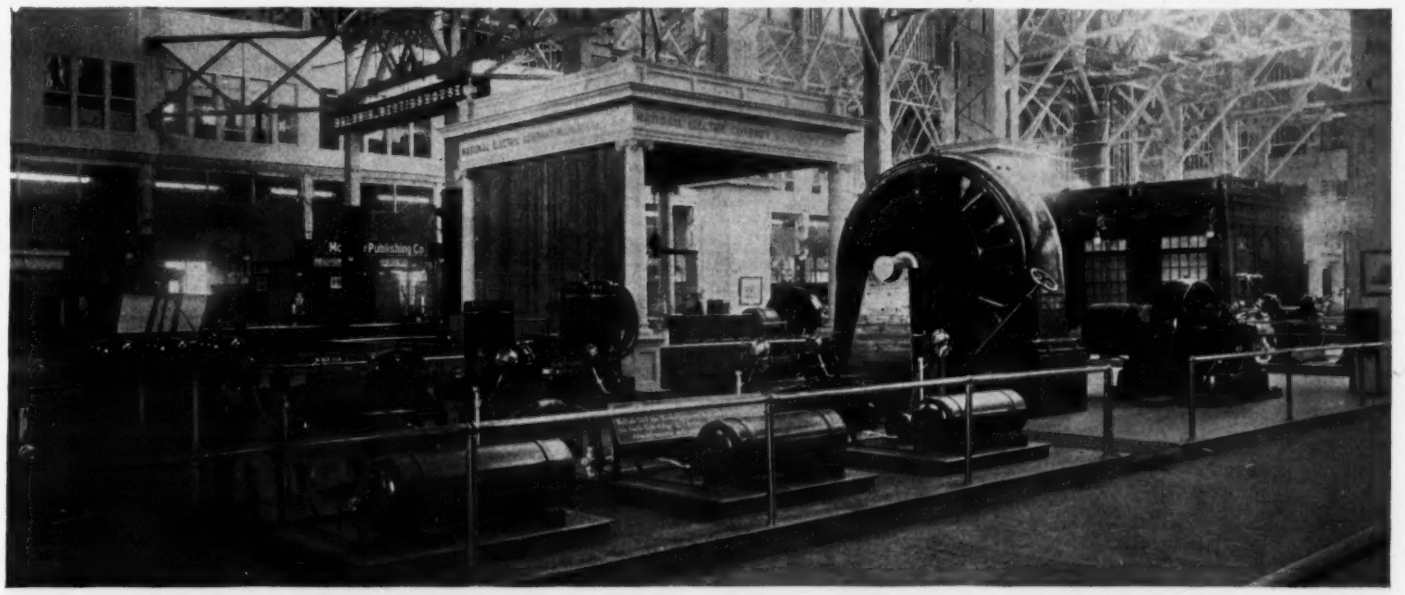


FIG. 1.—EXHIBIT OF NATIONAL ELECTRIC COMPANY IN ELECTRICITY BUILDING.

age is obtained from a liberal use of ventilating spaces in the assembled core. The conductors, of 37 x 28-in. copper, are placed 14 per slot, there being six slots per pole, each 1.5 in. wide and 2.5 in. deep.

The construction of the revolving field is such that it serves as

an additional fly-wheel for the engine. The revolving part is of steel, cast in halves, accurately machined and held together by links which are laid in position while hot and allowed to shrink to place. Cast-steel pole pieces are carefully fitted to the rim of the wheel and held firmly in place by means of bolts. Low temperature in the field winding is secured by exposing to the air the edge of each of the 65 turns of copper strap. The revolving structure weighs approximately 22 tons and is 16 ft. in diameter, the air-gap having a depth of ⅜ in. on each side. The complete alternator weighs approximately 60 tons.

The alternator has the following characteristics: Short-circuit current at full-load excitation, 450 amp.; regulation at 100 per cent. power factor, 5.5; regulation at 0 per cent. power factor, 22.0; efficiency at one-half load, unit power factor, 94.75; efficiency at

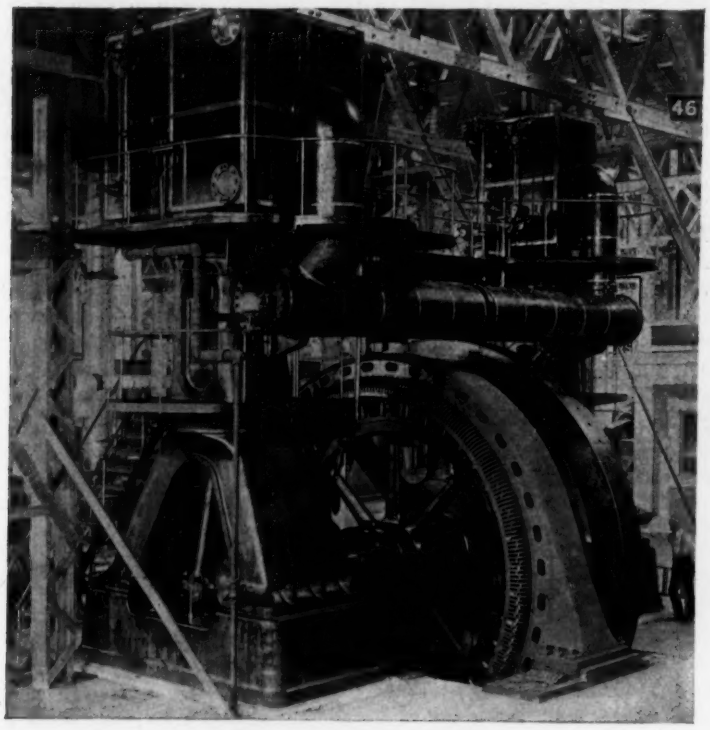


FIG. 2.—1500-KW NATIONAL ELECTRIC ALTERNATOR IN MACHINERY BUILDING.

1 per cent. load, unit power factor, 95.50; efficiency at 1¼ per cent. load, unit power factor, 95.50.

This alternator is excited from a 45-kw motor-generator set, run from the 220-volt lighting mains, the field current of the alternator being regulated by means of a rheostat in the shunt circuit of the exciter.

On Friday, July 15, the pit was flooded with water, but the machine was dried out and in operation on the following Monday. This alternator has on several occasions been short-circuited, due to trouble on the switchboard and mains, but has not been disabled in any way.

Some Telephone Exhibits at the World's Fair.

The telephone classification embraces a number of notable exhibits in the Electricity Building, occupying over ten thousand square feet of floor space and representing every important line of telephone development. Not only are the exhibits representative, but the booths are as a class the finest in the building. The Western Electric Company and the Kellogg Switchboard & Supply Company have installed two complete exchanges which are operated by the American Telephone & Telegraph Company and the Kinloch Telephone Company respectively. These two exchanges, together with that of the Automatic Electric Company, were fully described in the ELECTRICAL WORLD AND ENGINEER of July 29.

There are two retrospective exhibits in this class, one of the early Bell apparatus in the space of the American Telephone & Telegraph Company and the other showing the "Evolution of the Independent Telephone," a collection made by B. F. Wasson, of Clinton, Ill. In the Wasson collection there are a great many interesting curics which show the development of the independent telephone from its beginning up to the present time. The early telephones have not been overlooked; the tin can, the gold beater skin, the taut wire acoustic, the sheep bell generator, which is run by tapping a pencil on a diaphragm that rings a bell at the other end by means of a taut wire; samples of almost all of electrical generators of note up to the present, having two to eighteen bars, ringing through resistance from twenty to one hundred thousand ohms. Different kinds of transmitters are shown, including the carbon pencil and other different granular carbons, the old Harrison, all classes of receivers with wooden, rubber and composition shells, many kinds of hooks and arm rests which avoided the Watson patent. There are also cases with specimens showing the evolution of the fuse, the evolution of the insulator, as well as that of the smaller construction materials.

The instruments shown in glass cases in the exhibit of the American Telephone & Telegraph Company are of special interest to all who care to know of the early beginnings of the telephone and the days of small things, in the history of speech communication of the world's great agencies for eliminating time and space. The fragments here shown are the essential parts of the first electric telephone that ever transmitted speech. The single-pole membrane telephone shown is the identical instrument which was used at the

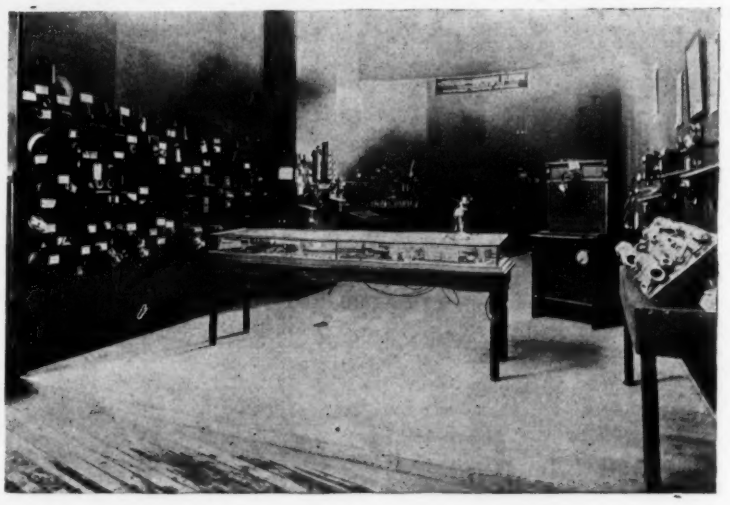


FIG. 1.—EXHIBIT ILLUSTRATING THE EVOLUTION OF THE INDEPENDENT TELEPHONE.

Centennial Exposition of 1876 by Professor Bell, Sir William Thomson, the Emperor of Brazil and others, when the first public exhibition of the speaking telephone was given. In Alex. Graham Bell's patent of March 7, 1876, this apparatus is described and illustrated as "Figure 5," and by this name it has become known. Two instruments like this were used and properly connected with battery in circuit. The two reeds were turned to the same note, and the vibrations of either reed, however caused, would produce at once a similar vibration in the other. This instrument is of peculiar historical interest, because its operation determined the fact that extremely feeble electric currents flowing in a telegraph circuit could and would produce at a receiving station an exact facsimile of the motion which had induced them. Bell's double-pole membrane telephone is similar to No. 7, with the exception that the electromagnet is of horseshoe form, with the two poles adjacent to the diaphragm. It was used both as a receiver and as a transmitter. In June, 1876, on the occasion of the electrical transmission of speech in the presence of the judges of electrical exhibits of the Centennial Exposition, it was used as a transmitter. A microphone is shown, made by Francis Blake, for use in his early experiments looking to the production of a commercial transmitter. There is also an Edison transmitter formerly standard for exchange use. Many other items might be enumerated in this valuable collection, and everyone interested in the telephone should give it close inspection.

Three exhibits of automatic telephone exchanges give the visitor a promise for the future in this field. The Automatic Electric Company, the Faller Automatic Exchange Company, and the American Telephone & Telegraph Company all have automatic exchanges in operation. The exhibit of the Faller Automatic Company, on the northwest corner of Section Twenty-four, will contain four telephone exchanges representing two new systems. This exhibit con-

sists of two important items. One is an entirely automatic machine operator, which does away with the human operators altogether, but is different from other automatic systems as it retains, in identical form, the present scheme of line circuits in a telephone system and accessories, and eliminates only the operator, substituting therefor a machine. With the single exception of the method of transmitting the number of the subscriber wanted, each function gone through in a manual switchboard has its exact counterpart in the Faller self-acting exchange or mechanical operator, and consequently it contains the equivalent of the means whereby connection is established between subscribers, as in the present manual boards, namely, jacks, plugs and cord circuits.

This system has already been fully explained in ELECTRICAL WORLD AND ENGINEER. The mechanical operator is a machine run by power, with no magnets except for releasing. It has no multiples; therefore it is simple in construction and easily taken care of. It is suitable for the largest sized exchanges, which is made possible by the fact that it has no multiples. It gives very speedy service, a trunked connection being made in about four seconds. The method of making a call is simple, and easy for the subscriber; merely to line up the numbers on rings running on centres, and turning a knob. The machine takes up about one-quarter of the space on a floor that is now required for manual multiple exchanges; and another feature is that the exchange can be divided up into sections and put on a number of floors, or into any number of places in a city, and yet work through one central exchange. There is no conversation whatever between the subscriber and the operator. The connection

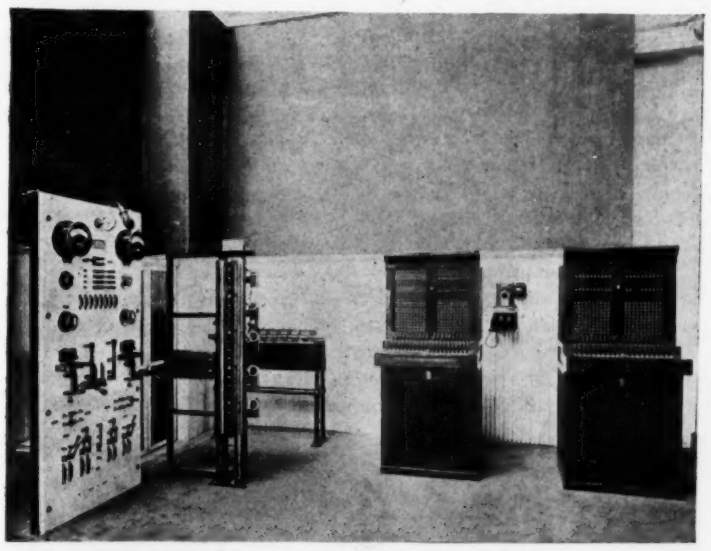


FIG. 2.—FALLER TELEPHONE COMPANY'S EXHIBIT.

is made in four and a half to five seconds, the conversation is perfectly secret, and there can be no interruptions.

The ordinary commercial telephone is employed, without any modification, and the switchboards, keys, relays, etc., at present in use are all utilized. The calling of one subscriber to another is done in the same way as in the full automatic. The figures are set on the numerical rings, so that the desired number is displayed across the sender, and the subscriber gives the knob a turn. This is the only operation he performs, and the act of operating a knob gives him access to the exchange. At the exchange, the operator simply sees a lamp light, and she plugs instantly into the jack under the lamp. Another lamp lights, which is the trunk lamp, selecting the section, either in the same or distant exchange in which there is the called subscriber's number. The operator in the other exchange or section sees a lamp light and instantly plugs in the same manner. She pulls a key, and the bell rings. If the bell rings once, it means that the line is ready for conversation; if twice, that the "line is busy, call again."

The Gray Telephone Pay Station was the first to make a machine for collecting telephone tolls automatically without an attendant. Later, the registering meter was added, and of all these types there are now about one hundred and fifty thousand in use by the telephone companies. These sets are established in depots and stores for use of non-subscribers. The call is made in the usual way, and when the connection is complete the operator requests the payment of the proper amount, which may be five to ten cents for a local call, fifteen to thirty for a suburban call, and any amount up to nine dollars for a long-distance call. If it is five cents, the user deposits it in the proper slot and the coin strikes one bell; if it is ten cents, two bells; if twenty-five cents, one clock gong; if fifty cents, two clock gongs; if one dollar, a large bell and a rattle. The operator understands this code and will not let the user talk until the right amount is paid. With the measured service register the operator asks the user to register when the connection is ready and a

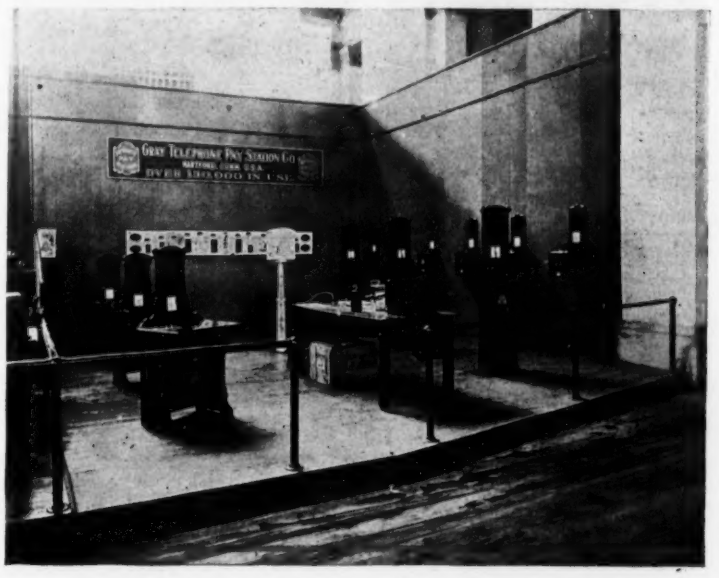


FIG. 3.—EXHIBIT OF GRAY TELEPHONE PAY STATIONS.

key is turned or a plunger pressed which makes a signal that the charge has been registered and shows up another connection on the counter. At the end of the month or quarter the bill is made from the record, which the user has in plain view at all times. It is considered in many quarters that measured service, or "pay as you go," is the only fair way to adjust telephone rates, for then the subscriber pays only for the actual number of connections used.

The American Electric Fuse Company exhibits some of its standard protectors connected to an electric circuit to show the operation

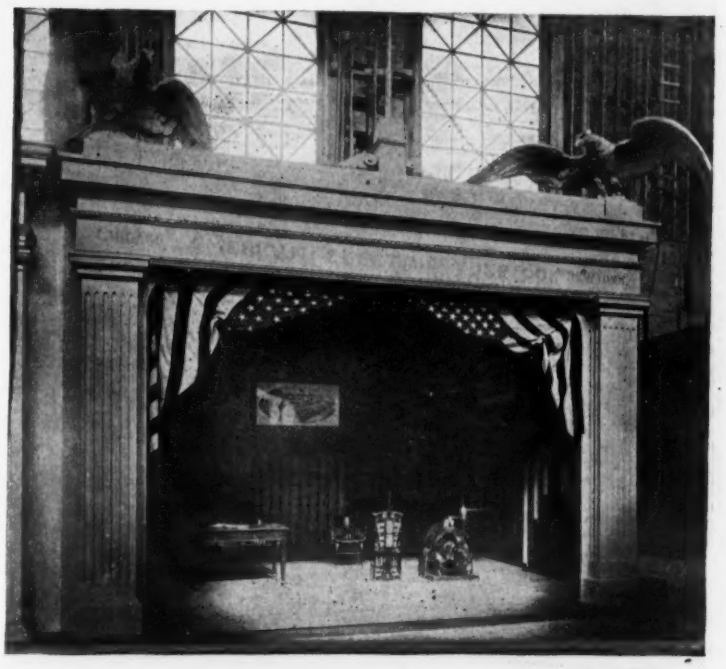


FIG. 4.—BOOTH AND EXHIBIT OF AMERICAN ELECTRIC FUSE CO.

of the coils. A protector and distributing frame has 2,000 pairs. Three sizes of rheostats from 10 to 100-hp capacity are installed and one of them connected to a motor to show the infinite gradations of speed. Next the wall are panels containing the small parts and specialties of this company.

In Section 23 are the exhibits of the Central Telephone & Electric Company, the American Electric Fuse Company and the D. A.

Kusel Telephone & Electric Manufacturing Company. The Central Company has installed a fine line of telephone apparatus and has a working exhibit showing telephone parts in the process of manufacture; also a central agency exchange, a magneto-bell and an intercommunicating house telephone system in operation, while an artistic booth encloses the entire exhibit.

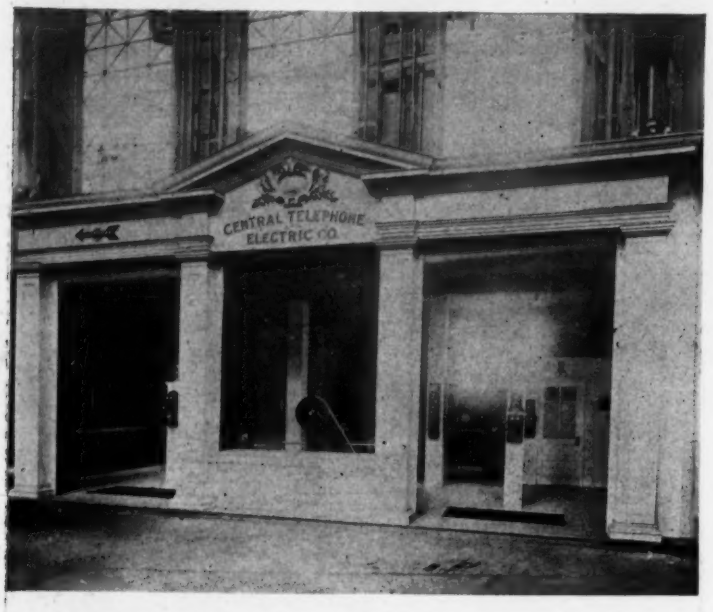


FIG. 5.—BOOTH OF CENTRAL TELEPHONE & ELECTRIC CO.

The Baird Manufacturing Company exhibits a line of telephone pay stations and measured service equipment. In the exhibit the special features are iron case pay stations of from one to five slots, which are made so that they can be attached to any style of telephone apparatus and will operate over any telephone line, as no electrical wiring is required, owing to the fact that the signals are transmitted entirely by vibration. The Baird Company also has two slot machines for 5-cent and 10-cent coins, and for 10 cents and 25 cents. All of the iron case Baird pay stations have the following distinctive features; loud signals, rejector pocket, flipper to prevent the deposit of more than one coin at a time, air valve to make the machine noiseless in operation, single lever operating all channels, large coin capacity, simplicity of construction and operation, one piece case casting, muffler to cut off signal on return of lever, combination lock giving security. Besides pay stations, the Baird Company exhibits a line of call registers and telephone time stamps, peg counters, wall cabinet and desk cabinet pay stations which are particularly suited for use in booths. The new model prepayment coin collector is for use on party lines, and is operated electrically.

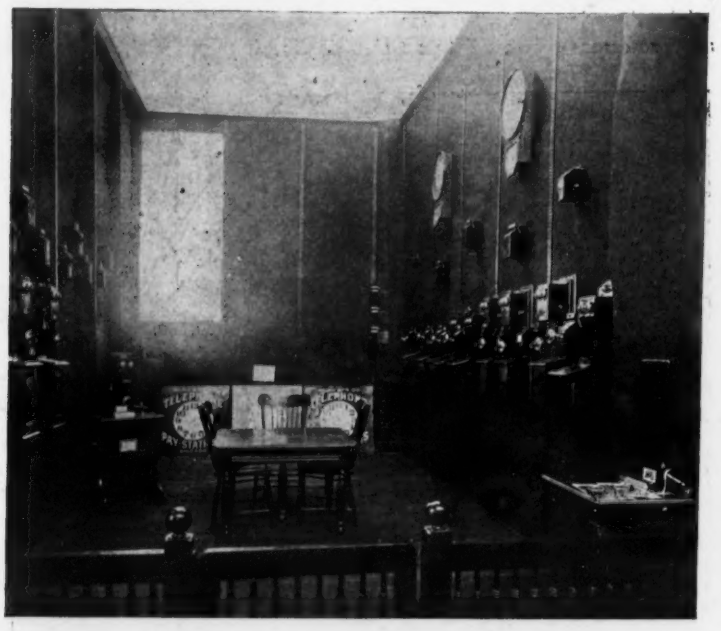


FIG. 6.—EXHIBIT OF BAIRD TELEPHONE PAY STATIONS.

The Kusel exhibit contains several styles of telephones, switchboards, exchange equipment, supplies and accessories manufactured by this company. The switchboards and telephones are in working connection to demonstrate their practical operation.

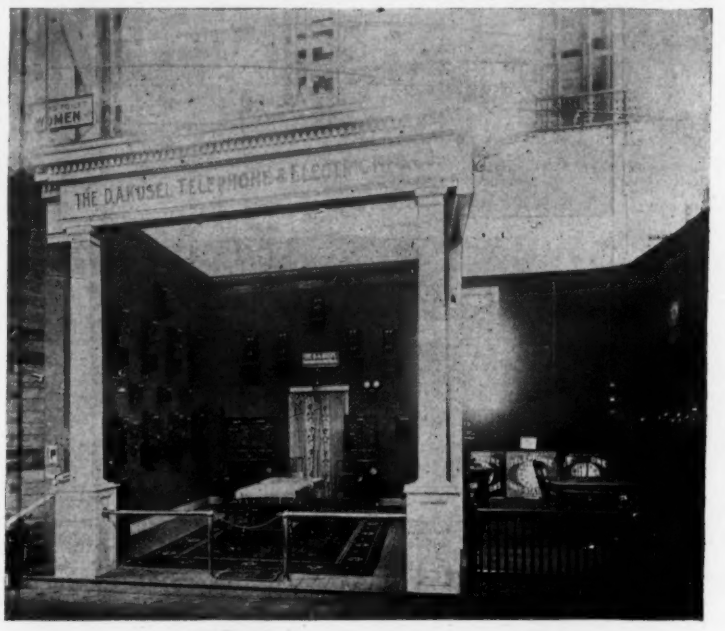


FIG. 7.—EXHIBIT OF THE D. A. KUSEL TELEPHONE & ELECTRIC MFG. CO.

The exhibit of the Sumter Telephone Manufacturing Company, of Sumter, S. C., located in Section 14, embraces several different types of magneto and central energy telephones, both wall and desk sets of the standard exchange types, also inter-communicating and hotel 'phones especially adapted to interior systems, together with several sections of the Sumter "bull's eye" express switchboards, hotel telephone annunciators and toll line switchboards. This company manufactures all parts entering into the construction of the entire line of instruments, and a very attractive feature of the exhibit are the beautifully finished telephone and switchboard cabinets, made in fancy woods from the native forests of South Carolina. The magneto telephone sets, smooth running and large capacity generators, hook switches, the excellent ringer construction, and the high efficiency of the transmitter and receiver, are worthy of note. The central energy telephones exhibited are equipped with special long-distance transmitter, double pole receiver, condenser, etc., and adapted to all common battery systems. The various types of interior telephones are also equipped with long-distance transmitter, double pole pony receivers with concealed cord terminals, and gravity hook switch, double gong battery bells of easy adjustment and a special induction coil. The Sumter express switchboards shown have the Mason "bull's eye" drop with inwardly falling shutters, and embrace valuable features in reference to jack and drop combination "bull's eye" signal, accessibility of parts and simplicity in construction and operation.

FIG. 8.—EXHIBIT OF SUMTER TELEPHONE MFG. CO.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The unfavorable crop reports and rising grain prices apparently had no effect on Wall Street, for the stock market was strong in tone with a bullish sentiment in possession. Money is still a drug on the market and this condition had the effect of stimulating further investment-buying of standard shares. The United States Steel stocks reacted moderately on the unfavorable trade developments of the week, but received support from the large short interest which has been outstanding. Traction stocks were strong and active, the three New York interests being concerned in reports of deals, which caused further rises in the prices of these securities. Some of the industrial specialties also made some gains in an irregular way. Among the electrics quietness prevailed. Allis-Chalmers common lost ½ point on the week's business, the closing price being 11, while General Electric and Westinghouse both made gains. The former closed at 165, an advance of 1 point, and the latter at 159¼, a gain of ¼ point. Westinghouse first preferred dropped 10 points, the last quotation being 180. The sales of Metropolitan Street Railway for the week aggregated 130,900 shares, the prices ranging between 121½ and 125⅜, the closing figure being 121⅜, representing a net loss of 1⅝. Manhattan Elevated gained 4 points, closing at 154¾. American Telephone & Telegraph dropped ⅜, closing at 139, and Western Union gained ¾, the last quotation being 89¾. The curb market for outside securities was of a fluctuating character, which was probably due to manipulations. The general list, however, was steady, following the lead of the main exchange. Interborough Rapid Transit led the list with an extreme rise of over 13 points, most of the improvement being retained. This stock closed at 147 bid, 149 asked. Following are the closing quotations of August 22:

NEW YORK

	Aug. 16	Aug. 23		Aug. 16	Aug 23
Allis-Chalmers Co.	11	10⅞	Electric Vehicle	9	10⅛
Allis-Chalmers Co. pfd.	47	47	Electric Vehicle pfd.	13	16½
American Tel. & Cable.	89	89	General Electric.	164	163½
American Tel. & Tel.	138	137⅝	Hudson River Tel.	..	..
American Dist. Tel.	22	22	Interborough Rap. Tran.		147
Brooklyn Rapid Transit.	53⅛	53⅜	Metropolitan St. Ry.	123⅞	121⅞
Commercial Cable.	181	180	N. Y. & N. J Tel.	151	152
Electric Boat.	39	39	Marconi Tel.		
Electric Boat pfd .	65	66	Western Union Tel	89	89⅝
Electric Lead Reduction.	⅛	⅛	Westinghouse com	159¼	158
			Westinghouse pfd	165	181

BOSTON

	Aug. 16	Aug. 23		Aug. 16	Aug. 23
American Tel. & Tel.	†	138	Western Tel. & Tel. pfd.	†	91
Cumberland Telephone.	..	117½	Mexican Telephone.	..	1⅛
Edison Elec. Illum.	..	261	New England Telephone.	..	123¾
General Electric	..	164¾	Mass. Elec. Ry	..	15
Western Tel. & Tel.	..	14	Mass. Elec Ry. pfd.	..	68

PHILADELPHIA.

	Aug. 16	Aug. 23		Aug. 16	Aug. 23
American Railways.	49	49	Phila. Traction.	98¾	98⅞
Elec. Storage Battery.	60	59	Phila. Electric.	6¼	6⅜
Elec. Storage Battery pfd.	60	59	Phila. Rapid Trans.	12⅞	13
Elec. Co. of America.	9⅜	9¼			

CHICAGO

	Aug. 16	Aug. 23		Aug. 16	Aug. 23
Central Union Tel.	..	..	National Carbon pfd.	107	110
Chicago Edison.	143	145	Metropolitan Elev. com.	18½	19
Chicago City Ry.	170	170	Union Traction.	4½	4¾
Chicago Tel. Co.	120	122	Union Traction pfd.	26	*30
National Carbon.	34	33⅜			

* Asked † Holiday

INTERBOROUGH RAILWAY PROSPECTS.—Earnings for the year are estimated equal to 5½ per cent. on Interborough stock. The charges on Interborough may be computed as follows: Interest on approximately $40,000,000 of bonds issued by New York City to pay for all expenditures in connection with work under the first contract, which embraced construction of the entire subway from the Federal building northward. At an average of 3.35 per cent. the interest payment amounts to $1,340,000 in connection with the work now completed. On the $3,000,000 bonds issued for the Brooklyn extension the interest is approximately 3½ per cent. or a total of $105,000, so that the entire fixed charges of Interborough amount to only $1,445,000. After surplus earnings from the subway lines become equal to 5 per cent. on Interborough stock the sinking fund payments of 1 per cent. additional on the bonds will have to be met, but at the start the only fixed charge will be bond interest amounting to $1,445,000. As the surplus for the year amounted to $1,925,724, it follows that Interborough's fixed charges have been earned, leaving a balance of $480,724 or slightly more than 1⅓ per cent. for the stock with only the elevated lines in operation. With the sinking fund in operation fixed charges will of course be increasd to $1,875,000. The particular result from electric equipment which gives greatest satisfaction is the gain in traffic during what used to be called the dull hours of the day. When the subway has been put in operation the elevated lines will in the first year under the new conditions earn a surplus of $1,000,000 above the full 7 per cent. dividend on Manhattan stock. Within two years, it is expected, the present conditions on the elevated road will be restored and Interborough may then be earning as much as 12 per cent. from its subway lines.

LEHIGH VALLEY TRACTION REORGANIZATION.—The plan of reorganization of the Lehigh Valley Traction Company system, including the Philadelphia & Lehigh Valley Traction Co., the Allentown & Slatington Street Railway Co., and the Copley, Egypt & Ironton Street Railway Company, is being mailed to the holders of bonds, stocks, evidences of indebtedness of and claims against the companies named, which holders may become parties to the plan of reorganization and obtain the benefits thereof by depositing on or before October 1, 1904, their bonds, stocks, evidences of indebtedness of and claims against the companies mentioned with either of the depositaries of the reorganization committee. A new company is to be formed, and the results of the plan are expected to work out as follows: Gross railway earnings, $884,000; operating expenses, including taxes, at 60 per cent., $530,000; net earnings from railways, $353,600; net earnings from electric lighting, $75,000; other income, $12,000; total net earnings, $440,600. Deduct fixed charges as follows: $2,770,000 first mortgage 4 per cent. bonds, $110,800; $1,830,000 first mortgage 5 per cent. bonds, $91,500; $300,000 Quakertown Transit Company 5 per cent. bonds, $15,000; rental Bethlehem & Nazareth Street Railway Company, $15,000; other rentals, $3,000; total, $235,300; which leaves a balance of $205,300; deduct interest on $2,030,000 consolidated mortgage 4 per cent. bonds, $81,200; surplus, $124,100. About 2½ per cent. on $5,000,000 preferred stock.

B. R. T. EQUIPMENT.—The annual report of President E. W. Winter, of the Brooklyn Rapid Transit Company, for June 30, 1904, says: "There was added to car equipment 200 new surface cars of standard size and design, 26 gondolas, 13 box cars, 7 express cars, 8 ice cars and 1 derrick car. The work of rebuilding and fitting elevated steam cars for electrical operation was carried forward to the full capacity of shop accommodations. The early part of the year 1905 should see this work on the elevated equipment completed, giving 270 closed electric standard trail cars and 357 standard motor cars, fully equipped with the multiple-unit control system, motors and automatic couplers, of which 48 will be the new turret type controller. There are now being received 100 new elevated cars, making a total of 457 motor and 270 closed trail cars. The central power station is practically completed and eight 4,000-hp units in operation. A portion of the block adjoining this station, purchased last year for reserve coal storage yard, was equipped with machinery for handling coal from barges and transferring the same, when required, from the yard to receiving bins in the central power house. The yard, as at present arranged, has upward of 75,000 tons storage capacity. There has been expended approximately $50,000 for improvements to reduce the fire hazard in the company's operating properties, resulting in decreasing the average rate of insurance 16.5 cents; or an annual saving in premiums of $14,821.83."

PHILADELPHIA KEYSTONE TELEPHONE.—The report of the Keystone Telephone Company, of Philadelphia, for the year ending December 31, 1903, is as follows:

Telephone rentals	$431,692
Other income	51,140
Total income	$482,832
Less rebates, etc.	13,972
Gross earnings	$468,860
Operating expenses	235,101
Net earnings	$233,759

The general balance sheet as of December 31, 1903, follows: Assets—Property and appurtenances, $7,695,224; current assets, $168,840; prepaid insurance and taxes, $8,744; material and supplies, $116,193; total, $7,989,001. Liabilities—Capital stock, $2,500,000; bonds, $2,500,000; real estate mortgages, $210,000; current liabilities, $2,516,855; accrued liabilities, $188,659; undivided profits, $73,487; total, $7,989,001.

PORTLAND, ORE., TROLLEY CONSOLIDATION.—The City & Suburban Railway Company will be consolidated with the Portland Railway Company, the new corporation to be called the Portland & Suburban Street Railway Company, capitalized at $4,000,000. The Portland Company is owned in New York and San Francisco.

WESTINGHOUSE ELECTRIC stockholders availed themselves very largely of the privilege of subscribing to the new stock. Three-quarters of the issue of 50,000 shares were underwritten before the offer was made to stockholders.

BUFFALO GENERAL ELECTRIC.—The stockholders of the Buffalo General Electric Company on August 17 voted to increase the capital stock of the company from $2,400,000 to $5,000,000.

DIVIDENDS.—Abingdon & Rockland Electric Light & Power Company has declared a semi-annual dividend of 2½ per cent.

Commercial Intelligence.

THE WEEK IN TRADE.—Conservatism in buying is the keynote, and the situation is not so full of life as at the corresponding season of recent years. No change is reported in the great industries. In cotton goods trade is somewhat backward, but in wool there is a firmer feeling and quiet buying. As to crops, the West complains of too little rain, while in the East and South there has been too much. The feature in the iron trade was the announcement of a wholesale cut in steel prices, particularly in wire and nails, and the practical dissolution of the pools in such products as structural material and plates. In industrial lines the building trades tie-up in New York City has been extended, and now involves, directly or indirectly, fully 45,000 men. Strikers in other principal trades bring the number of idle workers up to a high figure. There is a reported increase in the number of business failures, the aggregate for the week ending August 18 being, according to *Bradstreet's*, 203, against 167 the week previous. In the corresponding week last year the number was 166.

ANOTHER CONEY ISLAND SPECTACLE.—Announcement is made that a syndicate has bought all that section of meadow land extending in the rear of Coney Island Creek, from West End Bridge to Ulmer Park, and including a track about two miles long by one-half mile wide, for the purpose of building a new amusement park. It is declared that this park will eclipse anything yet attempted at Coney Island. The promoters of the new enterprise announce that it will be known as "Aerial Park," the name being derived from the numerous aerial attractions, such as airships, balloons, high causeways, flying machines, immense towers, and the like which they promise to have. A bicycle roller coaster, making a two-mile trip over the meadows to Ulmer Park and back again to Coney Island, it is said, will be one of the great features This, it is promised, will be the most exciting ride taken on any Coney Island resort. A miniature Niagara Falls is also to be one of the spectacular attractions promised. The main architectural feature, the promoters say, will be an immense tower, which will be at what is now known as the West End Terminal of the Brooklyn Rapid Transit Road. The railroad terminal will be the main entrance buildings of the new park, according to the plans presented by W. W. Doty, of 253 Forty-seventh Street, Brooklyn, who is the president of the Aerial Amusement Company. On the board of directors are J. B. Richards, Charles C. Grauten, Joseph C. Grauten, John C. Baker, Louis P. Jennet, Frederick Gerken, George T. Hanchett, the electrical engineer, and Leo Stevens, the aeronaut.

JULY EXPORT TRADE RETURNS.—The full July returns are compared in the subjoined table with returns of June this year and July of last:

	July, '04.	June, '04.	July, '03.
Exports:			
Domestic	$82,637,436	$90,890,719	$89,604,237
Foreign	2,245,995	2,345,061	2,209,028
Total exports	$84,883,431	$93,235,780	$91,813,265
Imports:			
Free	$31,566,521	$35,475,748	$89,604,237
Dutiable	39,556,999	45,685,094	2,209,028
Total imports	$71,123,520	$81,160,842	$91,813,265
Excess exports	13,759,911	12,074,938	9,625,442

The falling off shown is more than embraced in agricultural products which in July this year were $29,107,123, as compared with $38,768,877 in July, 1903, while on the other hand non-agricultural products were $55,776,309, a gain of about $2,750,000 for the month.

WESTINGHOUSE TURBINE CONTRACT.—The Tokio Electric Light Company, of Tokio, Japan, which operates the most extensive lighting plant in the Far East, has placed a contract for two 1,000-kw Westinghouse turbines for installation in its plant. The contract was closed through Takata & Co. Among other contracts for turbines which the Westinghouse Company has in hand is one for 1,500 hp for the Baltimore (Md.) Smelting & Rolling Company. Other domestic orders recently obtained call for two turbines of 500 hp each for the Philadelphia, Coatesville & Lancaster Railway Company; two of 650 hp each for the Union Metallic Cartridge Company, of Bridgeport, Conn.; one of 500 hp for the Parkersburg (W. Va.) & Marietta Interurban Railway; one of 650 hp for the Pennsylvania Light, Heat & Power Company, of Allegheny, Pa.; one of 650 hp for the Lewiston (Idaho) Water & Power Company. A Canadian order is also in hand for a 400-hp turbine for the Northern Engineering & Manufacturing Company, of Montreal.

A. L. IDE & SONS, Springfield, Ill., report the following among recent sales of their Ideal engines: one 100-hp, belted, to the Kirkwood Electric Company, Kirkwood, Ill.; one 100-hp, belted, Helena, Ark., Gas Company; one 35-hp, belted, Monterey, Mex., Electric Light Company; one 160-hp, belted, Spearfish, S. D., Electric Light Company; one 50-hp, belted, Port Gibson, Miss., Water & Light Department; one 175-hp, direct-connected, Village of Ada, Minn.; one 110-hp, direct-connected, Southern Hotel, St. Louis; one 60-hp, direct-connected, Waukesha, Wis., County Asylum; two 120-hp, direct-connected, Government Laboratory, Manila; one 100-hp, belted, Baltimore *Sun*, Baltimore, Md.; one 150-hp, direct-connected, Cass Water, Light & Power Company, Cass Lake, Minn.

THE STERLING ELECTRIC COMPANY, Lafayette, Ind., reports usual activity in its standard protective devices, having recently installed equipment for the following places: New York City, Savannah, Ga.; Findlay, Ohio; Jackson, Ohio; Crosswell, Ohio; Newall, Ohio; Aurelia, Ohio; Papillion, Neb.; Hazelton, Pa.; Reading, Pa.; Norwalk, Ohio; San Marcos, Texas; Springville, N. Y.; Winchester, Ind.; Tampa, Fla.; Boston, Mass.; Sidney, Ohio; Union, Mo.; Westfield, Pa.; Sherman, Pa.; Rochester, Ind.; Defiance, Ohio; St. Johnsbury, Vt.; Comer, Ga.; Oxford, Ohio; Clarion, Iowa; Deposit, N. Y.; Wells, Minn.; Zion City, Ill.; Lincoln, Neb.; Portland, Me.; Cleyburne, Texas; Topeka, Kan.; Swedesboro, N. Y.; Greencastle, Ind.; Fulton, Mo.; Herkimer, N. Y.; Hudson, N. Y.; Clinton, Iowa; Blairsville, Pa.; Angola, Ind., and Suffolk, Va.

ELECTRIC PUMPING PLANT FOR MINE.—The mines at Gold Hill on the Comstock Lode are to be drained by an electric pumping plant to be installed in the Alta shaft, which is 2,200 feet in depth. The success of the electric pumps in the C. & C. shaft in draining the mines at the North End led to the carrying out of plans for a similar plant in the Ward shaft, which will drain the middle mines, including the Chollar, Potosi and others. A chamber for the reception of the machinery is nearly completed at the 1,600 foot lead. Leon M. Hall, consulting engineer for the Comstock Pumping Association, will soon issue the specifications for the electric motors and pumps for the Ward shaft. There will be two units.

CURTIS TURBINES FOR NEW TRINITY BUILDING.—Curtis turbines are to be installed in the new Trinity Building, which is in course of construction by the George A. Fuller Company for the Equitable Life Insurance Society. This will be the first instance of turbines being utilized for lighting a large office building. There will be three machines in all, two of 150 kw and one of 75 kw capacity. The wiring of the building will be carried out by L. K. Comstock & Co., of 114 Liberty Street. Mr. John S. Griggs, Jr., of 25 Broad Street, is acting as consulting engineer for the electrical installation.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, for this time of the year is having an exceptionally good demand for its small village exchange and rural or country party line apparatus, having recently secured outside of its regular trade, contracts for equipment for Holdredge, Neb.; South McAlester, I. T.; Fayetteville, Winnamac and Grass Creek, Ind.; Pierre, S. D.; Svea, Minn.; Malvern and Tabor, Iowa; Baldwin, Kan.; Devine, Tex., and Hartland, N. B.

4,000-HP EQUIPMENT FOR COLORADO.—The Animas Canal & Power Company, of Durango, Colo., has just placed contracts for 8,000 hp of equipment to be installed in its hydraulic plant. The machinery will consist of two water wheels of 4,000 hp capacity, each direct-connected to 2,250-kw generators. The available head is 1,000 feet. The wheels will be Pelton, while the generators will be General Electric Company.

EQUIPMENT FOR WOODBRIDGE BUILDING.—The contract for the additional equipment to be installed in the Woodbridge Office Building, 100 William Street, New York, has been awarded to Mackenzie, Quarrier & Ferguson. There will be a 225-hp Harrisburg-Fleming four-valve engine to be direct-connected to a Westinghouse generator of 150-kw capacity. This outfit will be used for both light and power purposes.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, Ill., has recently closed contracts for switchboards with the following companies: Pfister-Vogel Leather Company, Milwaukee, Wis.; Davis & Means, Delmar, Iowa; Fayette County Telephone Company, Fayetteville, Tex.; Shelby Telephone Company, Shelby, Mo.

THE STANLEY ELECTRIC MANUFACTURING COMPANY has the contract to furnish a new 800-kw generator for the Hoosac Valley Street Railway Company. The price is $20,000.

EQUIPMENT FOR SCHOOL.—W. M. Sheehan & Company, of 136 Liberty Street, have secured the contract for installing the electric equipment in School No. 24, Manhattan Borough, for $5,765.

General News.

THE TELEPHONE.

NOME, ALASKA.—The Alaska Telephone & Telegraph Company, of New York, has been formed, capital $100,000. Directors: S. E. Boyd, of Nome, Alaska; W. H. Duval, E. D. Church, J. H. Emanuel, Jr.; P. V. R. Van Wyck, W. M. Lovering, A. C. Shenstone, W. H. Harding, Jr.; H. B. Haight and John Englis, of New York City.

FORTUNA, CAL.—The Upper Mattole Telephone Company has been organized with E. J. Etter as president, F. Rosece as secretary.

MILLVILLE, CAL.—A movement is now on foot to build a telephone line from Whitmore to Redding, connecting with the Sunset Company there.

LOS ANGELES, CAL.—The petition of the United States Long Distance Telephone & Telegraph Company, asking that a franchise be offered for sale covering Orange County, has been granted by the Board of Superiors.

SAN BERNARDINO, CAL.—Sealed bids will be received by the Board of Supervisors at San Bernardino, Cal., up to Aug. 29 at 10 a. m. for a franchise for a telephone and telegraph system, as applied for by Nathan W. Tarr. A certified check for $50 together with a certified check for full amount of bid required with the bid. L. A. Pfeiffer, County Clerk.

LOS ANGELES, CAL.—The Home Telephone & Telegraph Company of Riverside has placed the contract for the installation of a 750-telephone system by January, 1905, with the Empire Construction Company of Toledo, Ohio. It is reported that the company is contemplating long-distance extensions that will require approximately $1,000,000 worth of material. Extension toward San Francisco is said to be the plan.

FRESNO, CAL.—The expansion in two years of the Bell telephone system in the San Joaquin Valley has suggested a new division, with Fresno as headquarters. J. W. Gilkyson, of San Jose, who has been district manager there, has been appointed division superintendent. J. P. Noble will continue in charge of the Fresno District as manager. The new division includes the four districts of Fresno, Stockton, Visalia and Bakersfield.

CARRABELLE, FLA.—W. C. Lewis, of the First National Bank of Tallahassee, in connection with his partner, Dr. Moore, Mayor of Tallahassee, and a director of the Georgia Southern & Florida Railroad, has asked permission to erect an exchange here and put Carrabelle in connection with Thomasville, Ga., and Tallahassee by long-distance telephone.

COCHRAN, GA.—The local telephone system at Cochran has been bought by the Southern Bell Telephone Company, which will operate the newly acquired system.

OCOYA, ILL.—The Eppards Point Telephone Company, Ocoya, has been incorporated with a capital stock of $2500. The incorporators are W. E. Fisk, W. W. Osburn and W. W. Wagner.

INDIANAPOLIS, IND.—The Parke County Telephone Company of Indianapolis proposes to increase the capital of the company to $36,000 by the issuance of 480 additional shares of $50 each. The increase of stock will be offered to the present stockholders.

INDIANAPOLIS, IND.—According to the report of the Tax Commissioners the mileage of the lines of the allied Bell telephone companies in Indiana is 83,000 miles, and of the independent companies, 64,000, gains of 6000 and 16,000 miles respectively over 1903.

BLUFFTON, IND.—Fifteen farmers living near Domestic have organized an independent telephone company, of which they are the owners and builders. They are now having the lines, about four miles in length, strung, connecting all of their residences, and they will probably extend and take others in the system later.

CYPRESS, IND.—The Cypress Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $2500. The company will build an exchange in Cypress and lines of telephone throughout Vanderburg County. John F. Edmonds, John A. Neale, E. S. Long and A. E. Kamp are the incorporators.

INDIANAPOLIS, IND.—The Elkin Mutual Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $12,000. The company will operate a telephone system in Tipton and Hamilton counties, with the principal exchange in Elkin. W. A. Tiffin, Wm. Price, W. F. Small and others are the incorporators.

NEW CARLISLE, IND.—R. S. Underwood and W. G. Stedman, representing the Bell Telephone Company at South Bend, are establishing a new telephone exchange in New Carlisle. The Bell Company guarantees free service to both South Bend and Mishawaka, including the use of all farm telephones within a radius of ten miles of both cities.

ENID, IND. TER.—The Enid Rural Telephone Company, of Enid, has been incorporated with a capital of $30,000. The incorporators are Jerome S. Brooks, John P. Maddux and Harry N. Horner.

CENTERVILLE, IA.—The Appanoose County Telephone Company has filed incorporation papers. The incorporators are men living in and around the city who will build an exchange under the franchise recently given to the Exline Telephone Company which relinquishes its city franchise to the new company. The officers are: President, Newton Harris; secretary, A. B. Davison.

MENOMINEE, MICH.—The Michigan Telephone Company will establish a local exchange at Powers.

STOCKBRIDGE, MICH.—The Wing system of independent telephone lines affiliated with the Citizens' Telephone Company has made connection with the Washtenaw Home Telephone Company, giving a complete independent system between Jackson and Ann Arbor.

PENTWATER, MICH.—An automatic telephone exchange similar to the one at Grand Rapids is to be established at Pentwater by the Lake Shore Telephone Company. Because of increased territory and almost general county service the company has raised its telephone rental rates from $12 and $15 to $15 and $20, to take effect October 1.

ST. JOHNS, MICH.—The local telephone company at St. Johns, which handles an extensive rural service, is seeking to make its service indispensable by furnishing subscribers with the government daily weather reports and other important news of the day. Signals are rung each morning on all farm lines, and all who desire may get this report.

WELCOME, MINN.—The Armstrong Telephone Company has been granted a franchise for a local exchange.

BLOOMING PRAIRIE, MINN.—The Steele County Telephone Company will rebuild its local system and install new central apparatus.

NEW ULM, MINN.—The Minnesota Central Telephone Company is making great improvements on its lines and building a new exchange. Twelve or fifteen thousand dollars will probably be expended.

WINDOM, MINN.—The Windom Mutual Telephone Company announces that by Sept. 1 or very soon thereafter, the long distance line will be in connection with Sioux City, Sioux Falls, Luverne, Yankton and a number of other towns west of Windom. The line now reaches to St. Paul, Minneapolis, Duluth, Ashland, Superior, Austin and intermediate points. A copper circuit has been completed between Windom and the twin cities, and is now in operation doing excellent work.

MONROE CITY, MO.—The Farmers' & Merchants' Telephone Company, $3000 capital, has been incorporated by J. T. Spaulding, T. M. Boulware and others.

ROLLA, MO.—The Rolla Telephone Company has filed articles of incorporation. The capital stock is $20,000, all paid. The incorporators are Noel A. Kinney, Robert A. Love, C. E. French, A. L. McRae and James B. Harrison.

ST. LOUIS, MO.—Orders have been issued to place in service a telephone system on the Alton Railroad to connect the offices in St. Louis with Granite City. The composite system will be used and one of the copper telegraph wires will be connected with telephone instruments the same as are now in use between Bloomington and Auburn.

CLATONIA, NEB., is to have a new telephone exchange.

LINCOLN, NEB.—The Guide Rock Telephone Company has been incorporated with $8000 capital.

OMAHA, NEB.—The Interstate Telephone Company has applied for a franchise for an independent system here.

CHAMPION, NEB.—The Chase County Telephone Company has incorporated with a capital stock of $10,000, of which 5 per cent. is to be paid up. The principal place of business is Champion.

LINCOLN, NEB.—Thirty-five carloads of poles have been received at Lincoln by the Lincoln Telephone Company, to be used in the building of long distance lines. Work on extensions to Crete, Clatonia and Wahoo will begin at once, according to the decree of the stockholders.

OMAHA, NEB.—Two new telephone companies are now seeking franchises to do business in the city. One is the Victor Stevens syndicate from Eastern Iowa, represented locally by Blackburn & Spurlock, and the other, which will ask in a formal way for a franchise, consists of A. B. Hunt, E. E. Bruce, F. P. Kirkendall and C. L. Casey, a Michigan telephone man, and others. Each of the new companies claims that the other is backed by the Nebraska Telephone Company. Each claims to be an independent company. The Nebraska Telephone Company professes entire ignorance of either concern, except what has been published in the papers. The Hunt Company purposes to put in a plant with an automatic exchange at a figure somewhat lower than the present rates, while the Stevens, or Tri-City Company, offers still lower rates, but does not figure on an automatic exchange.

FANWOOD, N. J.—For the privilege of stringing its wires through the lower end of Fanwood Township, the Northeastern Telegraph & Telephone Company has paid the Township Committee $1000.

LANSING, N. Y.—The Farm & Village Telephone Company, of Lansing, Tompkins County, has been incorporated. Capital, $20,000. Directors: R. Miller, Rensselaer Miller and Ivan Miller, of Lansing.

TONAWANDA, N. Y.—The Bell Telephone Company of Buffalo is arranging to replace its local exchange with a handsome two-story brick building. The plant will be equipped with modern apparatus, providing improved service.

CANANDAIGUA, N. Y.—The annual meeting of the directors of the Seneca-Gorham Telephone Company was held at Stanley, and the annual report shows the concern to be in a prosperous condition. A 6 per cent. dividend was declared and plans were discussed for the extension of the lines. The capital stock was increased from $10,000 to $30,000. The company has now 60 miles of toll lines. The election of officers resulted as follows: President, John A. Driscoll, of Rochester; vice-president, Dr. D. S. Allen, of Hall's; secretary and treasurer, Rice Macauley, of Stanley.

NEW ROCKFORD, N. D.—The citizens of Freeborn and Morris will probably build a line from this place in the early autumn.

MT. BLANCHARD, OHIO.—The People's Telephone Company has increased its capital from $25,000 to $50,000.

HAMILTON, OHIO.—Manager Thompson, of the Hamilton Home Telephone Company, announces that it is the intention of the company to entirely rebuild the Scipio exchange.

TOLEDO, OHIO.—A meeting of the directors of the Peninsular Telephone Company, of Tampa, Fla., has been held in this city. A contract for enlarging the system was closed, and another for extended toll lines and connections is under consideration.

CLEVELAND, OHIO, will share in the extensions and improvements now being made in the Bell telephone system. The cost of the new exchange and the other work to be done in providing additional facilities for Cleveland telephone users will represent an expenditure this year of $150,000.

MARTIN'S FERRY, OHIO.—The reorganized Ohio Valley Telephone Company has elected Hunter S. Armstrong, president; George Walters, vice-president; Wilmer Steer, secretary. Plans for installing an up-to-date system were discussed and agreed upon. The plant will be put in first-class condition as soon as it can be done.

SANDUSKY, OHIO.—The Sandusky Telephone Company furnishes daily forecasts of the weather to 53 exchanges and toll stations. With these 53 exchanges there are connected at the present time 5260 subscribers. Of that number 876 are rural subscribers and 31 toll stations which are located in small hamlets. The territory covered includes the whole of Erie and Huron counties and parts of Sandusky, Seneca, Crawford, Richland and Lorain counties.

NEWBURG, ORE.—A mutual telephone company has been organized at Middleton with C. F. Barrett, president, and Chas. Ashpole, treasurer.

SALEM, ORE.—The Eugene, Elmira & Florence Telephone Company, with $1000 capital, will carry on a general telephone and telegraph business with headquarters at Elmira. J. F. Inman, F. C. Walters and others are interested.

SEASIDE, ORE.—A company incorporated by C. J. Curtis, J. W. Talbot and Dr. C. C. Talbot, with $10,000 capital, proposes to conduct a public telephone system and will ask the Council for a franchise. Telephones will be put in cottages and stores, and a connection made with the line to Astoria and Portland.

BASTRESS, PA.—A private telephone line is to be built through this township and will run to Collomsville.

PHILLIPSBURG, PA.—The Huntingdon & Clearfield Telephone Company is extending its line from Peale to Snowshoe.

DOYLESTOWN, PA.—Doylestown and other county towns are to share in concessions and improvements to be made by the Delaware & Atlantic Telephone Company. The underground system will be installed in Doylestown before cold weather and very soon the common battery system will be installed. One of the principal concessions is in rates, which will be much lower, giving unlimited service in Doylestown for a reasonable sum and under certain conditions allowing a certain amount of outside tolls.

WAYNESVILLE, S. C.—The Fuller Flume Company, of Waynesville, has secured a charter for telephone privileges and the building and operating of the same.

FRANKLIN, S. C.—The Franklin Telephone & Electric Company has been chartered with $15,000 authorized capital, by J. S. Trotter, of Franklin, J. H. Weaver, of Asheville, N. C., and others. The company contemplates putting in a telephone system and electric lights.

YANKTON, S. D.—It is understood a merger has been effected of the new telephone company here, the Bruce lines, the Independent Company at Sioux City, the Citizens' at Sioux Falls and the Ward lines. Lines will be built to Mitchell, Aberdeen, Watertown and Brookings.

SAN ANTONIO, TEX.—A new telephone line has been established between this city and Hacienda de las Vecas, the property of O. E. Darila.

JUNCTION CITY, TEX.—The Junction City Telephone Company has been incorporated with a capital stock of $5000. The incorporators are T. B. Phillips, M. E. Blackburn and T. J. Dailey, all of Junction City.

AUSTIN, TEX.—In the District Court August 7 the application of the Territorial Loan & Trust Company of Muscogee, I. T., for the receivership for the Commercial Telephone Company, was granted and the receiver will be appointed as soon as the parties at issue can agree upon a man for the place. The Commercial Telephone Company operates independent long-distance telephone systems in southeast and central Texas.

SALT LAKE CITY, UTAH.—Suit has been commenced by the Rocky Mountain Bell Telephone Company against the Utah Independent Telephone Company, in which the complainant asks that the independent company be restrained from using the same numbers in its business department as the Bell Telephone Company. A demurrer alleging insufficient cause for action is now under advisement by the court.

SALT LAKE CITY, UTAH.—An ordinance has been presented to the City Council providing for the granting of a franchise to the Postal Telegraph Company to erect and construct poles and conduits, etc., within the limits of Salt Lake City. It is provided in the ordinance that the life of the franchise be for a term of 100 years and that the Mayor and heads of departments shall be permitted to send telegrams free over the grantee's lines to the amount of $100 a year.

HOLLANDALE, WIS.—The Ridgeway, Jonesdale & Hollandale Telephone Company has been incorporated with $2000 capital stock, by R. Brunker and others.

MILWAUKEE, WIS.—The Hudson Prairie Telephone Company has been formed; capital, $3000. Incorporators: George Turner, Arthur McDiamid and G. E. Holden.

BRANTFORD, ONT.—The Chicago Telephone Supply Company, of Elkart, Ind., has made a reduction in its offer to install a municipal telephone system in the city of Brantford. Its first offer was for $40,000. A few days ago, however, the company made another and more satisfactory offer, proposing to install the system for $37,000.

OTTAWA, ONT.—The necessities of construction and development work in the New Ontario region have compelled the Ontario government to go in for a small measure of government ownership of telephones. A government telephone line is now being built from North Bay to the Temagami District, along the line of the new government railway. Another telephone line is also being built from New Liskeard to Haileybury.

ELECTRIC LIGHT AND POWER.

BRIGHTON, ALA.—The matter of installing a lighting plant here is being considered.

ABBEVILLE, ALA.—It was voted Aug. 8 to issue $20,000 bonds for constructing water works and an electric light plant. R. C. Bland is City Clerk.

LUVERNE, ALA.—A. B. Brooks, City Clerk, writes that it is hoped to be ready to receive bids about Sept. 10 for constructing an electric light plant, to cost about $8000. No engineer has been engaged as yet.

BIRMINGHAM, ALA.—A $300,000 electric plant will be erected at lock No. 3 on Coosa River in Alabama, to furnish power for the Annison, Gadsden & Birmingham Railroad. The promoters propose to erect a cotton mill and later on connect the towns mentioned by trolley.

SEARCY, ARK.—Bids are wanted Sept. 15 for an electric light plant at an estimated cost of $21,000. Emmet Snipes is secretary of the electric light committee.

MAMMOTH SPRINGS, ARK.—The Mammoth Springs Electric Light Company will, during the coming season, install a 90-kw, 3-phase, alternating-current generator for power.

WASHINGTON, D. C.—A certificate of reorganization of the Potomac Electric Power Company has been filed with the Recorder. The capitalization is to continue at $5,000,000, divided into 50,000 shares. Nine trustees are named to manage the company for the next year: George Truesdell, S. L. Shober, Jr., George H. Harries, James B. Lackey, W. F. Ham, George W. Young, Allan L. McDermott, H. W. Fuller and R. T. Duke, Jr.

EUREKA, CAL.—The Humboldt County Water & Power Company is perfecting its plans for a water and power system. A site near the Eureka water front has been secured on which to erect a steam power plant of not less than 1000-hp capacity.

SAN FRANCISCO, CAL.—The Westinghouse Electric Manufacturing Company has closed a contract to supply an additional electric mining installation at the Texas Flat mine in California. This mining company, in which Union Pacific Railroad officials are interested, generates its own electric power.

EUREKA, CAL.—The North Mountain Power Company has been incorporated by J. L. and F. J. Koster and others, with a capital of $500,000. A site for the power house has been secured near the drawbridge of the California & Northern R. R. over Eureka slough, and work on the structure will soon be commenced. The North Mountain Power Company is employing 250 men on construction work. The electric transmission line from the power site to Eureka, Cal., will be 65 miles in length. According to present expectations, sufficient machinery will be installed to permit of transmitting 2250 horsepower by Jan. 1, 1905.

SAN FRANCISCO, CAL.—It is stated that the Sierra Nevada Water & Power Company is planning to utilize the waters of the Mokelumne River in Calaveras and Tuolumne Counties to generate electric power for this city, and cities in the San Joaquin Valley and on the coast of Central California. W. G. Clark, of Seattle, Wash., is manager of the company.

DENVER, COL.—Geo. D. James, 519 Mining Exchange Building, Denver, representing Eastern capital, has several surveying parties in the field, for the purpose of gathering accurate data in Colorado, Utah, New Mexico, Arizona and California, to decide as to the feasibility for the generation of electric power from the facilities afforded by the largest rivers traversing those states and territories.

WINSTED, CONN.—The Winsted Gas Company contemplates the erection of a power house and will transmit electricity to surrounding towns.

BAINBRIDGE, GA.—The citizens have voted in favor of purchasing the present electric light system.

OCILLA, GA.—The City of Ocilla will advertise for bids during September for some new equipment, including 20 arc lamps and 750 incandescents.

NEWNAN, GA.—It is proposed to either purchase or construct an electric light plant at a probable cost of $20,000, and F. G. Farmer, H. H. North and T. M. Goodman are the names of the parties interested.

VIDALIA, GA.—J. W. Wiggins, general manager of the Vidalia Light & Water Company, states that he will build about 11 miles of new circuit for city lighting. It is his intention to consolidate the telephone, electric lighting, water works and ice plants.

KEWANEE, ILL.—The Kewanee Light & Power Company is to spend several thousand dollars on extensions.

FAIRBURY, ILL.—The Fairbury Electric Light, Heat & Power Company contemplates installing a 120-kw generator.

LITCHFIELD, ILL.—The newly-organized corporation will take over the Litchfield Gas & Electric Company. Some additional machinery has been purchased and will be installed.

CHICAGO, ILL.—Bonds to the amount of $5,000,000 have been sold, to be used for extending the Chicago municipal electric light plant, building bridges, etc.

ALPHA, ILL.—The Alpha Electric Light & Power Company contemplates establishing a service to Rio, Knox Co., during the coming fall, and possibly to Mola and North Henderson.

MEREDOSIA, ILL.—The Meredosia Light, Heat & Water Company has been incorporated, with a capital of $20,000, for the purpose of operating a heat, light and power plant. Incorporators: C. M. Skinner, J. W. Skinner and T. D. Beeley.

EFFINGHAM, ILL.—The Effingham Electric Light & Power Company proposes to re-build its entire system during the present year. The plans are not yet fully developed, but it is the intention to install a 225-kw alternating current machine, Corliss engine, boilers and other necessary equipment.

EDINBURG, ILL.—The Edinburg Light, Heat & Power Company has been incorporated with a capital stock of $30,000, by J. R. Harrington, L. E. Swigert and Reuben Wilkinson. The plant has been in operation about a year.

LAFAYETTE, IND.—The Merchants' Electric Light Association contemplates installing a 150-kw alternator.

WABASH, IND.—The Wabash Electric Light Company has changed its name to the Wabash Water & Light Company.

CONVERSE, IND.—The Converse Electric Company contemplates enlarging its plant and supplying power to two outlying towns.

SOUTH BEND, IND.—Some changes are to be made in the equipment of the plant of the South Bend Electric Company about September 1, by Mr. Wm. R. Smith, superintendent.

VINCENNES, IND.—The City Electric Light Company informs us that it will require considerable apparatus, including new boilers, engines and dynamos. It expects to extend its incandescent feeders and arc circuits.

MOULTON, IA.—The Moulton Electric Light Company is inaugurating a day power service.

DAVENPORT, IA.—An arrangement has been made between the railway company and the Davenport Gas & Electric Company whereby the latter agrees to furnish power for the new line.

WAUKON, IA.—The Waukon Electric Light Company is developing plans, in connection with the Decorah Electric Light Company, for a water-power plant on the upper Iowa River at a point about 12 miles from Decorah, to supply power to the two towns named and adjacent territory. The construction work will be started as soon as the enterprise can be financed.

HOPKINSVILLE, KY.—The Hopkinsville Gas Light & Power Company has been reorganized as the Hopkinsville Gas & Electric Company, with a capital stock of $25,000. W. T. Tamdy and Jas. A. Young, Jr., of Hopkinsville, are among the incorporators.

AMITE, LA.—The Amite Light & Power Company on Aug. 1 bought the old plant. It will install a new high-tension outfit. The company will supply electric light, water and ice, although it has not yet secured the necessary franchises. It will also endeavor to secure the lighting contracts in several nearby places.

ROCKLAND, MASS.—The Abingdon & Rockland Electric Light & Power Company has elected these officers: President, Lewis A. Crossett, North Abingdon; treasurer, Ronald McDonald, North Abingdon; clerk, Judge George W. Kelley, Rockland. The company did the best business in its history last year, and its net earnings were nearly $9000.

HOLYOKE, MASS.—A contract has been signed by Manager W. H. Snow, of the municipal gas and electrical department, for the new generator to be placed in the electric light plant. The price agreed upon is nearly $6000. The balance of the $8000 appropriated by the aldermen for this purpose will be used in the foundation.

JORDAN, MINN.—The Jordan Electric Light & Heat Company contemplates installing a storage battery plant and a day power-circuit.

SOUTH STILLWATER, MINN.—The village of South Stillwater has awarded the contract to the American Electric Company for a direct connected unit and other equipment for the proposed extensions. Mr. Walter Hill is chief engineer.

OXFORD, MISS.—The Town Council has decided to issue $8000 bonds to establish a new electric light plant.

MISSOULA, MONT.—The Missoula Light & Water Company contemplates establishing a steam auxiliary plant of 500-hp capacity, also a new sub-station and office building.

BOZEMAN, MONT.—The Gallatin Power Company has been incorporated with a capital of $150,000, for the purpose of establishing a power plant at Sheep Rock. Directors: E. J. Carter, Geo. Cox, E. W. King and others, all of Bozeman.

JOPLIN, MO., is about to issue $30,000 bonds for improving the city light plant.

ST. JOSEPH, MO.—Bonds to the amount of $75,000 have been voted for an electric light plant at St. Joseph.

CANTON, MO.—A new electric light plant which was established by the town authorities is now in operation. When completed it will cost the town $16,000.

LEXINGTON, MO.—The Lexington Gas & Electric Company proposes to make extensive alterations to its present system and will require considerable new equipment, including arc lamps, new boilers, engines and dynamos, meters, transformers, etc. The entire town will be re-wired.

COLUMBIA, MO.—The formal transfer of the property of the Columbia Water & Light Company to the City of Columbia took place Aug. 1, the purchase price being $67,000. The property consists of water works and an electric light plant. It will be controlled by a board of public works of four members.

TRENTON, MO.—The Trenton Gas Light & Power Company plant, which has just been rebuilt, is constructing a water-power plant on Grand River. This work will cost $50,000 when completed, and the plant will have an approximate capacity of 500-hp. Turbine wheels will be installed. The new generating plant will be finished about Dec. 1 this year.

ST. LOUIS, MO.—It is practically settled that the Laclede Gaslight Company and the Union Electric Light Company will be domiciled with the Kinloch Telephone Company in the structure to be erected by the latter at the northwest corner of Tenth and Locust Streets. The building will be 12 stories in height and will cost approximately $500,000. The three upper floors will be retained by the Kinloch Telephone Company, for its general offices and exchange. The switchboard and equipment for the exchange will cost $300,000. Provisions have also been made in the new quarters for the Long Distance Telephone Company, which, it is said, is allied with the building company.

FREMONT, NEB.—Improvements are to be made to the lighting plant, at a cost of $6500.

RENO, NEV.—The Nevada Transit Company, with a capitalization of $250,000, has filed articles of incorporation with the Secretary of State.

LITTLE FALLS, N. Y.—The plant of the Consumers' Electric Company was recently destroyed by fire.

CAZENOVIA, N. Y.—The Cazenovia Electric Company is rebuilding and extending its lines, putting them all underground in fibre conduit.

NEW YORK, N. Y.—Mayor McClellan has authorized the issue of $140,000 special revenue bonds for the purpose of lighting public schools during the year 1904.

FULTON, N. Y.—The Board of Public Works has awarded the contract for lighting the city for a period of 10 years to the Fulton Light, Heat & Power Company, at $75 per light.

NEW YORK, N. Y.—The Lozier Light & Power Company has been incorporated with a capital of $100,000. Directors: Edwin R. Lozier, Henry A. Lozier, Jr., and Samuel Regan, of New York.

BOONFORD, N. C.—The Estatoe Electric Company, which was organized a year ago, has not yet awarded the contract for the construction of its plant; it is expected, however, that the work will be started in the near fuure.

CANANDAIGUA, N. Y.—The A. L. Swett Electric Light & Power Company, of Ontario, N. Y., has been incorporated with a capital stock of $300,000. The directors are Alfred L. Swett, Arthur J. Howard and F. Marion Poles.

ASHEVILLE, N. C.—The Asheville Cotton Mills recently contracted with the W. T. Weaver Power Company to supply electric power to run the mill.

SHELBY, N. C.—The Lily Mill & Power Company has awarded the contract to the General Electric Company for one 700-kw generator, water wheels, etc. The plant is now in process of erection and will be ready for operation about January 1, 1905.

GRAHAM, N. C.—The town of Graham has voted in favor of water and electric lights and the contract has been forwarded to the Southern Service Commission, Washington, D. C., whose acceptance is practically assured. J. C. Simmons is Mayor.

BUFFALO, N. Y.—A certificate of incorporation of the North Electric Company has been filed in the office of the County Clerk here. The company has been capitalized at $2500. Its directors are F. J. Luedeman and William and A. Schubert, of Buffalo, and E. M. Andrews, of Rochester.

GRAHAM, N. C.—The Town Commissioners have decided to replace the present street lights and water tanks by an up-to-date system of electric lights and water works. They have contracted with Mr. H. L. Milner, of Morganton, representative of the Southern Service Corporation, of Washington, D. C., to put up 20 or more arc lights, aggregating 40,000 candle power, and 30 fire hydrants for the town, at a cost of $2400 a year. Private parties will be supplied at proportionate rates.

HICKSVILLE, OHIO.—The Hicksville Electric Light Company proposes to install another 50-kw dynamo.

ADA, OHIO.—The Ada Water, Heat & Light Company has increased its capital stock from $75,000 to $100,000. C. B. Ames is the president.

FREMONT, OHIO.—The Fremont Power & Light Company, which was organized in March of this year with a capital stock of $350,000, has not yet awarded the contract for the construction of its plant. The power equipment will include three 500-kw units. The company will engage in city lighting.

SIDNEY, OHIO.—The Citizens' Light & Power Company, of Sidney, Ohio, has been incorporated, capital stock $150,000. The company is formed for the purpose of furnishing electric current for heat, light and power and also for producing steam and hot water for heating and power. Among the Columbus men interested are George T. Spahr, Andrew Dobbie and Fred W. C. Bailey.

SOMERSET, PA.—The Town Council has granted Jas. M. Coyer, Jas. McKelvey and Fred Biesecker a franchise for an electric light plant.

READING, PA.—The Sinking Springs Electric Light, Power & Heat Company, at Sinking Springs, this county, has been granted a charter and expects to furnish light about Oct. 1. The officers are: President, William F. Krick; vice-president, Thomas H. Krick, and treasurer, Henry H. Yost.

SINKING SPRINGS, PA.—The Sinking Springs Electric Light, Power & Heat Company, has been granted a charter with W. F. Krick as president.

MAHANOY CITY, PA.—A charter has been granted to the Buck Mountain Light, Heat & Power Company, capital $10,000. Directors: Harrison Ball, of Mahanoy City; T. D. Jones, of Hazleton; F. P. Spiese, of Tamaqua, and others.

SLIPPERY ROCK, PA.—It was voted Aug. 9 to construct an electric light plant and water works. Address J. C. Ricketts, secretary.

BEECHCREEK, PA.—The Town Council has passed an ordinance granting to W. P. Mitchell, of Indianapolis, Ind., and N. J. Mitchell, for a corporation to be formed by them, the exclusive right for 99 years to establish a system of water works, electric lighting and sewage. The water is to be taken from Cove Run, near Mapes, where a reservoir will be built. It is proposed to extend the water works to Blanchard. The electric lighting plan includes the furnishing of light to this borough, Blanchard and Howard. Two years is given for the completion of the electric light system. The persons interested will at once form a company and apply for a charter.

BATESBURG, S. C.—This town has awarded the contract for the new water and electric light system to Frederick Minshall, of Abbeville, S. C.

FORT MILL, S. C.—The directors of the Catawba Power Company at Fort Mill at a recent meeting decided to increase their capital stock from $750,000 to $850,000.

NEWBURY, S. C.—This town has purchased from the General Electric Company a new lighting outfit, consisting of two dynamos, 65 street lights, switchboard, etc. The new equipment cost $5905.

BELTON, S. C.—The Belton Power Company contemplates the construction of a water power plant and the transmission of electric power. The probable cost is $250,000. J. E. Swinnie, Greenville, S. C., is engineer.

ARLINGTON, TEX.—The Arlington Light & Power Company has been incorporated, with a capital of $10,000. Incorporators: Wm. Dugan, W. C. Weeks, W. L. Sweet, and others.

McKINNEY, TEX.—It is reported that the contract for the electric light system to be installed in connection with the water works system will be awarded Aug. 31. The plans provide for increasing the size of the water works pump station so as to include the light plant, the installation of an additional dynamo, 9 miles of wire, 45 arc lights of 2000 candle-power each, etc.

SALT LAKE CITY, UTAH.—The plant of the Salt Lake City Water & Electrical Power Company has been sold at public auction. The purchase price was $37,500, although the upset price fixed by the court was $45,000. The property was acquired by W. S. McCormick, of this city. The sale has not yet been confirmed by the court, and creditors have filed notices, claiming the right to redeem in case the price does not cover the amount of their claims.

LYNCHBURG, VA.—The Lynchburg Water Power Company's plant is almost completed. All of the power developed will be taken by the Lynchburg Construction & Light Company.

MARION, VA.—The Marion Light & Power Company will be in the market for a 100-kw, 60-cycle, 3-phase alternator. The company is now building a dam which will have a capacity of 150 horse-power.

CAMBRIA, VA.—The Unique River Light & Water Company has been organized with a capital stock of $10,000. James Rigby, Sr., is president and general manager, James Rigby, Jr., is vice-president and C. L. Borden, secretary. The construction of the company's plant is to be started in about two months. The company expects to engage in city lighting. It will float bonds to complete the work.

ABERDEEN, WASH.—The Aberdeen Electric Company has sold its plant and franchises to the Gray's Harbor Electric Company.

SEATTLE, WASH.—Plans have been filed for the construction of the power sub-station of the municipal lighting plant.

PIEDMONT, W. VA.—The Piedmont Electric Light & Power Company, of which Mr. H. B. Carroll is general manager, will add one 200-kw Warren alternator to its present equipment.

LAKE GENEVA, WIS.—The Equitable Electric Light Company will extend its lines around Lake Geneva during the coming year.

HAZELGREE, WIS.—The citizens have voted in favor of issuing $6000 bonds to install an electric lighting plant and water works.

MILWAUKEE, WIS.—The plant of the Fox River Valley Gas & Electric Company has been purchased by the Wisconsin Light, Heat & Power Company.

LADYSMITH, WIS.—The Ladysmith Light & Power Company contemplates developing a water power on the Flambeau River, 4½ miles south of this place.

VIROQUA, WIS.—The Viroqua Electric Light Company expects to add one 75-hp Corliss engine and one 50-kw alternating current generator during the present year.

OSHKOSH, WIS.—All of the property of the Oshkosh Electric Light & Power Company, which has been for the last 18 months in the hands of a receiver, was sold at public auction, Aug. 11, for $215,000 to W. H. Whitney, of Boston.

ROSSLAND, B. C.—The Canadian General Electric Company has closed the contract to supply the Pacific Coal Company with electrical apparatus for the Bankhead colleries. The electrical and steam plant complete and ready for operation will cost $50,000.

TORONTO, CAN.—The Southern Light & Power Company has been incorporated with $300,000 capital, by C. A. Stone, D. A. Dixon and others.

LUNENBURG, NOVA SCOTIA.—The Lunenburg Gas Company will be in the market later on for a 200-kw plant. The company is now increasing the head of its water-power from 16 ft. to 25 ft.

KINGSTON, ONT.—On August 1 the city took over the works of the Kingston Light, Heat & Power Company and will in future operate them. The city will employ experts to report upon the condition and requirements of the present plant, both gas and electric, and will make such extensions and alterations as may be recommended.

OTTAWA, ONT.—Mr. R. S. Kelsch, of Montreal, has been in Ottawa in connection with certain improvements to the plant of the Hull & Ottawa Power Company, which is installing a new set of water wheels, a 2000-hp generator and a new switchboard. The company will furnish electric power to the new works of the International Portland Cement Company, at Hull, Que., which will utilize 3000 electric horse-power. Mr. Kelsch has recently concluded a contract whereby the Montreal Light, Heat & Power Company has entered into an agreement for a term of years to supply the Montreal Street Railway with 7000 horse-power per year at $25 per horse-power.

SHAWINIGAN FALLS, QUE.—It is stated that the Westinghouse Electric & Mfg. Company has secured from the Shawinigan Falls Water & Power Company the contract for a 2-phase, rotating field alternator of 6600-kw capacity and 2200-kw transformers. The price is reported to be nearly $200,000.

SHERBROOKE, QUE.—The municipal ownership party of this city has again sustained a defeat at the polls in respect to the control of the electric light and power supply to the city. It was proposed to issue bonds to the amount of $200,000 for the purpose of purchasing the plant of the Sherbrooke Light, Heat & Power Company or to install a new electric plant.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The stockholders of the Birmingham Railway, Light & Power Company have decided upon a $10,000,000 bond issue. The greater part of the issue will be used in carrying out projected and actual improvements.

FORT SMITH, ARK.—H. M. Byllesby & Company, of Chicago, Ill., have been appointed engineers for the Fort Smith Light & Traction Company. Extensive improvements and extensions to the electric light, gas and street railway properties will soon be undertaken.

LOS ANGELES, CAL.—The American Rail Clamp Company has incorporated here, with a capital stock of $10,000, fully subscribed. Directors: A. M. White, R. N. Walton, E. C. Walton, H. J. Woollacott, M. M. Berkeley.

SAN JOSE, CAL.—Promoters of the electric railway up Mount Hamilton to Lick Observatory have decided to incorporate a company with $20,000 capital to make the preliminary surveys, estimates of cost and secure franchises. After the necessary work is done an effort will be made to sell bonds in the East for the construction of the road.

CLINTON, IA.—C. H. Decro, of Moline, Ill., contemplates extending an electric line from Albany to Morrison, thence to Clinton.

BALTIMORE, MD.—Work on the Northern Central Railway Company's enlarged electric power station at Mount Vernon yards is being rushed, and the plant will be ready for operation in about six weeks. When completed it will furnish power for lighting purposes at Union and Calvert Stations, and for lighting and power at the Mount Vernon shops. The railroad company will continue to get power from the United Electric Light & Power Company for lighting purposes at its President Street station and Jackson's wharf.

DUXBURY, MASS.—The Plymouth County Street Railway Company has been granted a franchise here. The company plans to build a line to connect the South Shore towns and summer resorts with Brocton, Rockland, Whitman and Abington.

MANKATO, MINN.—M. G. Willard and his associates have been granted a franchise to build an electric railway here. The plan is to extend the line to St. Clair and Madison Lake. A company is to be organized with a capital stock of $700,000, divided into $550,000 common stock and $150,000 6 per cent. cumulative preferred stock. A bond issue is to be authorized.

GRENADA, MISS.—There is a movement under way among the citizens of the town to organize a stock company, with a capitalization of $30,000, for the purpose of constructing and operating an electric railway, the proposed line to extend from the Illinois Central depot through the business portion of the city to the extensive tie plant of the Ayer & Lord Company, about 3 miles from the point of beginning.

CAMDEN, N. J.—The Monterey Electric Railway, Light & Power Company, Camden, N. J., has been incorporated to acquire and develop railways in Mexico. The capital is $225,000. Incorporators: William T. Wheeler, E. E. Walker and T. H. Beckett, of Camden, N. J.

ALBANY, N. Y.—The Canton Electric Traction Company, New York, has been incorporated, capital $20,000. Directors: G. Mazacorati, R. L. Spotts and P. M. De La Chesnaye, New York.

NEW YORK, N. Y.—The contracting firm of Naughton & Company, which holds the contract for the construction of the trolley line to be built across the new Williamsburg Bridge, has sub-let the work of constructing the overhead equipment to J. G. White & Company. The steel poles have already been contracted for by the latter concern with the Elmer P. Morris Company, of New York.

ASHEVILLE, N. C.—A movement is on foot looking to the establishing of an electric railway from Asheville to Hendersonville. The distance between the towns is 28 miles.

WAYNESVILLE, N. C.—Work has begun at Pigeon River, 6 miles above Waynesville, on an electric power plant that will eventually mean an electric railway for these parts. The proposed line will run from the Southern Railway Depot to Eagle's Nest. Benjamin Sloan, proprietor of the Haywood White Sulphur Springs Hotel, and S. C. Satherwaite, proprietor of Eagle's Nest, are interested.

SALEM, ORE.—Articles of incorporation of the Portland Southern Electric Railway Company have been filed. The capital stock of the corporation is given as $1,000,000, and the incorporators of record are L. B. French, of Detroit, Mich.; W. J. Cook, of Astoria; M. J. Kinney, G. W. Waterborg and C. W. Miller, of Portland, and J. H. Albert, of Salem.

PORTLAND, ORE.—The Mount Hood Electric Company has been incorporated for the purpose of supplying this city with electricity for commercial uses. It is also said to be the intention of the new company to build a trolley line to the base of Mount Hood. The power is to be obtained on the Sandy River, about 25 miles east of this city. The company is capitalized at $1,000,000. The incorporators are C. W. Miller, an attorney of this city; G. W. Waterbury, also of Portland, and Edwin D. Whitney, of Chicago.

PHILADELPHIA, PA.—A permit has been granted by the Board of Highway Supervisors to the Philadelphia Rapid Transit Company to extend its Twenty-second Street and Allegheny Avenue tracks from Nineteenth and Chew Streets to the city line at or near Cherry Lane or Weaver Street. The extension is to be 100 ft. wide, over private property, belonging to the company, and will consist of a double-track railway which will connect with a line recently laid in Montgomery County, across country, to Willow Grove.

MEYERSDALE, PA.—Contracts have been let for the construction of an electric railway from Garrett, Pa., through the Meyersdale region to Frostburg, where connection will be made with the Cumberland & Westernport system, which traverses the George's Creek region 30 miles. The new line will be known as the Meyersdale & Salisbury Railroad. The company is capitalized at $1,500,000, and it is understood that before the road is in operation

about $800,000 will have been expended. The officers of the company are Orran W. Kennedy, of Uniontown, president; H. L. Borland, president of the Union Realty Company, of Pittsburg, treasurer, and W. J. Ward, secretary.

PORTLAND, ORE.—The Portland Southern Electric Company of Salem and Portland has been incorporated with $1,000,000 capital. The company will build an electric line from Portland to Salem.

KNOXVILLE, TENN.—The Mentor Southern Railway Company has been incorporated with a capital stock of $50,000. Directors: J. H. Ribgold, J. B. Wright and others.

KNOXVILLE, TENN.—It is announced that the Knoxville Traction Company will expend $500,000 in building a line through West Knoxville and making improvements on the system.

BEAUMONT, TEX.—The Board of County Commissioners has granted a franchise to the Port Arthur & Southern Electric Railway Company for relaying an electric line in Port Arthur.

TORONTO, ONT.—The Metropolitan Electric Railway, which runs from Toronto to Newmarket, a distance of 30 miles, has been sold to the Toronto Electric Railway. The Schomberg & Aurora Electric Railway, which runs from Aurora on the line of the Grand Trunk to Schomberg, has also been sold to the Toronto Electric Street Railway Company. The Toronto & York Radial Electric Railway Company, which recently received a charter, has sold its franchise to the Toronto Electric Street Railway.

HAMILTON, ONT.—Engineer W. F. Jennings, of the Toronto & Hamilton Electric Railway, has submitted to the City Council plans showing the route which the road will take from Toronto to the frontier at Niagara. The line will cross Burlington Beach on the Grand Trunk right of way, and an hourly service with cars running at a high rate of speed will be given. The company intends to construct a loop line into Hamilton, and will carry freight as well as passengers.

NEW INDUSTRIAL COMPANIES.

THE MADISON ELECTRIC COMPANY has been formed in Chicago; capital $2000, for maintaining machinery. Incorporators: E. J. Ryan, John Felker, Fred C. Bender, Barton Parish.

THE CLINCH ELECTRIC COMPANY, of New York, to act as electricians, has been formed with a capital stock of $3000. Incorporators and directors for the first year: E. S. Clinch, Jr., and others.

THE NATIONAL CONSTRUCTION & SUPPLY COMPANY has been incorporated at St. Louis with a capital stock of $20,000. The object is to build electric railways. The incorporators are Horace S. Rumsey, T. M. Jenkins, Joseph Clark, Geo. D. Rosenthal and James McCaffrey.

THE WARNER ARC LAMP COMPANY, of Muncie, Ind., has incorporated with a capital stock of $50,000. The company proposes to manufacture arc lamps, mechanical and electrical apparatus, motive power equipments, etc. The principal plant and office will be in Muncie. William F. Warner, C. L. Warner and John H. Raulings are the incorporators.

THE E. P. SMITH ELECTRICAL CONTRACT COMPANY has filed articles of incorporation in Dubuque, Ia. The principal place of business is to be in Dubuque. The capital stock is $10,000, divided into one thousand shares of $10 each and business may be commenced when not less than $5000 of the stock is subscribed.

LEGAL.

HOUSEMOVING AND TELEPHONE WIRES.—The point as to whether or not the moving of a house is an ordinary use to which a street may be put will probably decide the question of the right of the council to compel the Duluth Telephone Company to remove its wires to permit the passage of a building. The supreme courts of some of the Eastern States have held that moving a house along a street is not an ordinary use of the street, but the point has not yet been settled by the supreme court of Minnesota. It will, however, come up just as soon as the next application is made for an order to the company to open its wires. When the former ordinance was tested the council ordered the telephone company to open its wires, and when the company failed to do so, the manager was arrested for violating an order of the council. He then entered a motion to dismiss on the ground that the ordinance was not valid, and the motion was upheld. The mode of procedure will probably be much the same in this instance, and the matter promises to come into court on the first occasion that the council orders the wires to be opened. The case will probably be carried through the local courts to the State Supreme Court, as both the company and the city are anxious to have the point definitely settled.

PERSONAL.

PROF. FERDINAND WEBER, of Zurich, Switzerland, has been appointed by the Swiss Government delegate to the International Electrical Congress.

PROF. CHARLES ZIPERNOWSKY, of Budapest, will be in attendance at the International Electrical Congress at official delegate from Austria-Hungary.

PROF. JOHN PERRY, past-president British Institution of Electrical Engineers, will attend the International Electrical Congress as one of the official delegates from Great Britain.

PROF. G. ARRHENIUS, of Sweden, is on a visit to the University of California. During the International Electrical Congress Prof. Arrhenius will represent Norway and Sweden as official delegate.

MR. JOHN HESKETH, electrical engineer of the Postmaster General's Department, Brisbane, Australia, is in this country and will be in attendance at the International Electrical Congress as official delegate from Australia.

PROF. G. GRASSI, successor to the late Prof. Ferraris at the Museo Industriale, Turin, is on his way to the United States, to be in attendance at the International Electrical Congress as a delegate from the Associazione Elettrotecnica Italiani.

MR. ALEXANDRE ZELEWSKY, chief engineer of Ganz & Company, Budapest, is in the United States in order to attend the International Electrical Congress. Before returning home Mr. Zelewsky will visit some of the Far-west power transmission plants.

PROF. ALBERT W. SMITH, who recently left Stanford University, where he had been at the head of the department of mechanical engineering, has gone to Ithaca to assume control of the Sibley College of Engineering at Cornell University. Professor W. F. Durand has succeeded Professor Smith at Stanford.

MR. GUSTAV OBERG, the secretary and general manager of the Shanghai (China) Mutual Telephone Company, is now on his way back to the Far East, after securing considerable data on this side. The Shanghai system is to be doubled in capacity. Mr. Oberg's report, it is understood, will embody recommendations regarding the purchase of considerable American equipment.

MR. J. K. ROBINSON, of Iquique, Chili, who represents the interests of the Westinghouse and Standard Underground Cable Companies on the west coast of South America, will leave for the United States next week. While here he will make his headquarters with the William E. Peck Company in the Centennial Building, 116 Broad Street. Mr. Robinson is understood to have lately secured some fair-sized orders for various machinery which he will place here.

MR. WILLIAM ALBERT HALL, former vice-president of the Lawrence Hall Electric Company, has opened offices in the Union Trust Building, Cincinnati, Ohio. He has secured the representation of some good manufactures, and with his wide acquaintance in his vicinity, and his experience in making sales, he is in a position to benefit the manufacturers who have entrusted their material to his hands. Mr. Hall is in a position to take the agency of one or two more specialties.

Trade Notes.

THE FARNSWORTH ELECTRICAL WORKS, San Francisco, Cal., M. A. Farnsworth, president, has moved from 185 Jessie Street to larger quarters at 111 Jessie Street.

THE CENTRAL ELECTRIC COMPANY, Chicago, announces that it is prepared to quote prices on repairing burned out transformers of the core type of any make, and assures its customers that any orders sent it will receive prompt and careful attention. The company, as sales agent for Pittsburg transformers, states that it has experienced a very gratifying business so far this year, with numerous prospects for good orders ahead.

THE EUREKA ELECTRIC COMPANY, of Chicago and Genoa, Ill., has now in press, and will be ready for distribution Sept. 1, a telephone work containing valuable information, statistics and data that will be of service to every telephone man. The work is entitled "Independent Telephone Practice," and was compiled by Mr. I. J. Kusel and A. E. Dobbs, two well-known independent telephone men. The work will be distributed by the Eureka Electric Company, and will be sent upon application.

WARD LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., has issued a new catalogue covering its resistance units No. 19038. These resistance units are of the enameled type, and various methods of mounting them are shown. The company reports several large orders for its resistance units mounted for telegraph and telephone purposes. The convenience of mounting and the fact that the resistance wire is protected from atmospheric conditions by a coating of enamel places such units in great demand.

NEW ECONOMIZER CATALOGUE.—That the B. F. Sturtevant Company of Boston, who has recently moved to its new office and works at Hyde Park, Mass., is to press the sale of its economizers is evidenced by the new economizer catalogue which it has recently issued. This catalogue contains the details of the Sturtevant Standard and Pony types of economizers in comparison with those of other makes, the advantages, sizes, weights, accessibility, repairing, etc. It also treats of the subject of mechanical draft and natural draft and is of interest to all steam users. It may be obtained by anyone interested in the subject.

MULTIPLE VOLTAGE SPEED CONTROL OF ELECTRIC MOTORS.—In straight multiple voltage work alone, without field control, the motors are operated up to their limit only on the lowest speed. By using shunt field control alone, the loads are limited by their capacity at the highest speeds. Therefore by properly combining multiple voltage and field control, the advantages of both systems are retained, and by the proper use of field circuit resistance to weaken the field of the motor to a point where the capacity is just equal to that given on the lowest voltage, there is obtained a system which requires the minimum sized motor, and which will work this motor over the maximum range of speed. Upon these facts is based the Bullock multiple voltage system, for which the apparatus required for a three-wire circuit includes a generator (250 volts), a balance consisting of two comparatively small machines (90 and 160 volts), and a controller for each motor. The four-wire system requires a balancer consisting of three machines coupled together (60, 80 and 110 volts) giving 60, 80, 110, 140, 190 and 250 volt circuits. This system of control is described in bulletin No. 1028 of the Bullock Electric Mfg. Company.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 16, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

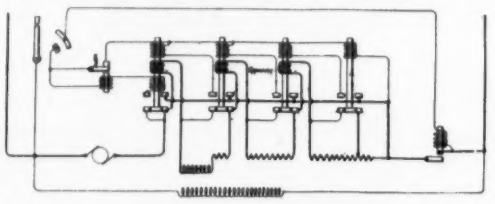
767,408.—STARTING DEVICE FOR VAPOR ELECTRIC APPARATUS; Peter Cooper Hewitt, New York, N. Y. App. filed May 28, 1903. This invention resides in the arrangement of the starting-band. The container has the negative electrode of conducting material within it and a re-entrant portion arranged to enter the negative electrode, and the starting-band is located within the re-entrant portion.

767,437.—SELF-SOLDERING FUSE-POST; Claude R. Pitrat, Chicago, Ill. App. filed Feb. 25, 1903. The invention consists of a cut-out for telephone and telegraph lines, comprising a graphite body of proper resistance having metal ends, a rotary detent fitted to one of said ends, having a series of teeth, a cementing substance for securing the detent against movement under normal conditions, and adapted to be fused or softened upon the passage of a current of abnormal strength through said body, and a spring secured to said body and tending to rotate the said detent.

767,463.—SECTIONAL ELECTRIC CONDUIT; Charles E. Wilson, Philadelphia, Pa. App. filed Dec. 14, 1901. The conduit is formed by the juxtaposition of conduit sections of substantially square cross-section, having longitudinal grooves coincident with the median lines of each of the four sides, with alignment-pins interposed at promiscuous intervals along the length of the grooves, each of said pins engaging the sides of the two sections between which it is placed.

767,491.—DIRIGIBLE TORPEDO; David Wiley McCaughey, Chicago, Ill. App. filed March 20, 1902. The purpose of this invention is the same as that of the preceding patent, the same consisting of propelling mechanism for the torpedo, rudder mechanism, an electric motor connected with the propelling mechanism and arranged to be operated by either continuous or alternating currents, an electric motor connected with the rudder mechanism, a single line-wire connecting the said motors with the shore, a continuous current generator, an alternating current generator, and a switch for cutting either of such motors into or out of the single-line circuit.

767,492.—DIRIGIBLE TORPEDO; David Wiley McCaughey, Chicago, Ill. App. filed April 30, 1902. According to this invention a torpedo is provided with electrically-actuated mechanisms which may be controlled by an operator stationed at a distance from the torpedo, either on the shore or on another vessel, the torpedo and the mechanism therein contained being constructed in such a manner as to be operated directly and controlled by such operator from the shore by means of "electrical oscillations" or



767,691.—Motor Control.

"Hertz electric waves." A reversible electric motor for operating a movable part of the torpedo, is employed, in connection with an electro-magnetically operated switch to cut the motor into and out of circuit with the source of energy, an electric oscillator at the operating station for generating electric waves or impulses, and a coherer on the torpedo arranged to be acted upon by the electric waves and electrically connected with the switch-operating mechanism to operate the same.

767,497.—MULTIPLE SECONDARY TRANSFORMER; John S. Peck, Pittsburg, Pa., and Charles Le G. Fortesque, Wilkinsburg, Pa. App. filed Aug. 8, 1903. (See Current News and Notes.)

767,503.—EARTH SHIELD FOR TRANSFORMERS; Charles F. Scott, Edgewater Park, Pa. App. filed Sept. 16. 1903. (See Current News and Notes.)

767,534. CONDUCTOR FOR ELECTRIC RAILWAYS; Arthur Whittier, Wollaston, Mass. App. filed Sept. 8, 1903. One of the track rails is formed of insulated sections with a continuous conduit therein. In this conduit is located a metallic channel which is insulated from the rail sections and is connected to the source of current supply. Located within the conduit and resting upon the channel is a chain, the different parts of which are adapted to be successively elevated by means of electro-magnets carried by the car, so that the current-collecting devices on the car may draw current from the main conductor through said chain.

767,554.—METHOD OF RENDERING STORAGE BATTERY GASES NON-EXPLOSIVE; Thomas A. Edison, Llewellyn Park, N. J. App. filed Nov. 28, 1902.

767,593. MASSAGING IMPLEMENT; Alvah U. Patchen, Syracuse, N. Y. Application filed May 9, 1903. Two electrodes are arranged in the electric circuit, one in advance of the other, one of the electrodes having an intermittent action, means being provided to produce said intermittent action.

767,599.—ELECTRICALLY OPERATED APPARATUS; Charles E. Sedgwick and Walter H. Abbott, Cleveland, Ohio. App. filed Sept. 17, 1903. The device comprises a shell having a reversely inclined bottom with its highest point at the center, an electrical winding about said shell, extending across both sides of its center, and a ball in said shell adapted to be electrically drawn from one side of the shell to the other across its center.

767,625.—ELECTRIC CIRCUIT CLOSER FOR FIRE ALARMS; John E. Bemiller and Emery C. Weisensale, Hanover, Pa. Application filed May 7, 1904. The circuit closer comprises a tube having a bulb therein adjacent to its lower end, an expansive fluid in said tube, an electric wire projecting into the expansive fluid and insulated from contact with the fluid except at one end, and a similarly insulated electric wire extending into the upper end of said tube.

767,629.—RAILWAY SWITCHING APPARATUS; John Pressley Coleman, Edgewood, Pa. Application filed Oct. 7, 1903. The invention resides in the means employed for giving an indication that the switch-rails have been completely moved and locked by the switch moving mechanism in the desired direction, and the same consists of a lever controlling the operation of said mechanism, a lock for said lever, electro-magnetic means for operating said lock which are responsive to alternating currents, a circuit for said electro-magnetic means, a source of alternating current supply for said circuit, and means for preventing said electro-magnetic means from responding to any current other than an alternating current.

767,681.—LAMP CLUSTER AND SWITCH; Reuben B. Benjamin, Chicago, Ill. Application filed May 7, 1903; renewed May 2, 1904. The device contains a main supporting base, a supplemental base in front of and parallel to the main base, a plurality of lamp-holding devices with their contacts located between said bases and a switch mounted upon the supplemental base for controlling the contacts of the lamp holding devices.

767,691.—MOTOR CONTROL; John D. Ihlder, Yonkers, N. Y. App. filed May 5, 1902. The purpose of the invention is to enable an electric motor to be automatically controlled in a way which decreases the liability of injury to the motor and prevents the starting current from rising beyond a predetermined amount. Any increase of current beyond the predetermined amount in starting so strengthens a series winding that the operation of cutting out resistance dies not continue until the current has again reduced to the desired amount. The controlling means for the motor is dependent for its operation upon the differential action of the potential and current of the motor armature.

767,692.—MOTOR CONTROL; John D. Ihlder, Yonkers, N. Y. Application filed May 8, 1902. This invention has the same object as that described in the preceding patent, and consists of a controlling magnet for the motor operated at line-potential, and means controlled by variations of motor current for varying the ampere-turns of said controlling magnet.

767,703.—AUTOMATIC ELECTRIC REGULATOR; Emanuel Levison, Mansfield, Ohio. App. filed Jan. 18, 1904. The invention resides in the means for cutting in or out electric circuits in starting a motor or generator. A compound winding is provided upon a magnet actuating a regulator having a shunt-coil in circuit with a motor and a series-coil in circuit with independent circuits or windings to be cut out, and with a line wire.

767,713.—SIGNAL FOR GRAIN BINS; John G. Raygor and Clifford Slife, Dedham, Ia. App. filed Sept. 17, 1903. A movable distributing spout and a plurality of bars into each of which the spout may discharge, are employed, in connection with a circuit closer in each bin, a battery and alarm circuit, and a switch in the circuit, connected to the spout, and movable therewith to connect the circuit to the device in the bin into which the spout is discharging.

767,751.—MEANS FOR CONTROLLING MOVEMENTS FROM A DISTANCE; Max R. Hanna, Schenectady, New York. App. filed Jan. 18, 1904. The invention is designed for controlling the position of the brushes of a plurality of motors on a car or train, or controlling the position of the movable contacts of rheostats or other regulators. A movable member is employed, in connection with a motor for driving the same, means for starting said motor, contacts in the circuit of said motor moving with said member and arranged to stop said motor upon reaching a predetermined point and means controllable from a distance for shifting the position of said point.

767,757.—ELECTRIC LOCK; Edward B. Jacobson, Pittsfield, Mass., and Earnest Blasser, Boston, Mass. App. filed Nov. 21, 1902. The invention consists of a part moving in unison with the knob spindle, ar electro-magnet, and a divided armature therefor, having its sections or halves constructed to mutually engage with said part.

767,759.—RECTIFIER FOR PERIODIC CURRENTS; Alexander D. Lunt, Schenectady, N. Y. App. filed Jan. 6, 1900. (See Current News and Notes.)

767,761.—CONTROL OF ALTERNATING-CURRENT MOTORS; Maurice Milch, Schenectady, N. Y. App. filed Dec. 29, 1903. (See Current News and Notes.)

767,764.—POWER FACTOR INDICATOR; Lewis T. Robinson, Schenectady, N. Y. App. filed Nov. 5, 1902. (See Current News and Notes.)

767,773.—POWER TRANSMISSION; William Stanley, Great Barrington, Mass. App. filed Nov. 30, 1903. (See Current News and Notes.)

767,777.—ELECTRICALLY HEATED TOOL; Tycho Van Aller, Schenectady, N. Y. App. filed Dec. 14, 1903. A tool, such as a soldering bar, is so supported that when released by the operator it will automatically reverse, so as to bring its operative face uppermost into position to receive the effect of the rising heat while at rest.

767,828.—ELECTRIC CONNECTION ROSETTE; Mortimer Norden, New York, N. Y. App. filed Jan. 12, 1903. Details.

767,833.—ELECTRIC CURRENT REGULATOR; Frank E. Phillips, Hyde Park, Mass. App. filed April 13, 1904. The device comprises a liquid receptacle, a terminal mounted therein and submerged in the liquid, a second terminal movable within the receptacle, a rack-bar connected with the second terminal, a rack-adjusting shaft, pawl-and-ratchet mechanism for holding said shaft, and binding posts in electrical communication with the terminals.

767,846.—BASE FOR ELECTRICAL FIXTURES; Louis Steinberger, New York, N. Y. App. filed June 1, 1903. Details of an insulating base adapted for switchboards and other small instruments employed in office work.

767,875.—ELECTRIC LAMP ATTACHMENT; Henry D'Olier, Jr., Philadelphia, Pa. App. filed July 15, 1904. The purpose of the device is to provide an attachment which will permit the employment of a plurality of ordinary incandescent lamps jointly in such position that their longitudinal axes may be maintained horizontal even when the lamps are suspended by a drop-cord.

767,889.—ELECTRIC SWITCH; Charles F. Hopewell and Charles H. Morse, Cambridge, Mass. App. filed Dec. 31, 1903. The invention consists of an actuator for a switch, which is especially designed for use upon electric cars running at high speed, the same comprising a frame or bar disposed in parallelism with the trolley wire and inclose proximity thereto, having one or more spirally-arranged ribs thereon which extend lengthwise of the frame or bar and which are adapted to be engaged by the trolley to turn the frame or bar on an axis in parallelism with the trolley wire, said frame or bar being connected with the switch and employed as the actuator therefor.

767,916.—RHEOSTAT; Irving B. Smith, Philadelphia, Pa. App. filed Dec. 3, 1903. The device comprises a switch base, a plurality of switch contact segments mounted thereon and each provided with an extension and resistance material wound substantially normal to said expansions and electrically connected thereto at intervals.

767,930.—SAFETY APPLIANCE AND SPEED-CONTROLLING APPARATUS FOR ELEVATORS; Theodor Eskilsson, Astoria, N. Y. App. filed June 6, 1904. The elevator is provided with a dynamo or magneto-electric machine having its armature connected to and driven by the source of power which drives the car, the same being used in connection with a brake normally held out of action, and electro-magnetic means operatively connected with said dynamo electric machine for applying the brake when the car reaches an abnormal speed.

767,939.—TROLLEY POLE HEAD; John E. Greenwood, Utica, N. Y. App. filed Aug. 29, 1903. Details.

767,948.—INSULATOR; Fred M. Locke, Victor, N. Y. App. filed Aug. 30, 1902. Details of an insulator which is capable of being subjected to great strain without liability of breaking.

767,952.—BLOCK SIGNAL; Charles H. Morse, Cambridge, Mass. App. filed May 22, 1903. A danger signal and a safety signal at each end of the block, together with circuits therefor, are employed, in connection with a signal controlling switch at each end of the block, a lighting magnet and a cutout magnet at each end of the block for operating the switch, circuits therefor, and means operated by said lighting magnet for reducing the attractive force of the adjacent cutout magnet.

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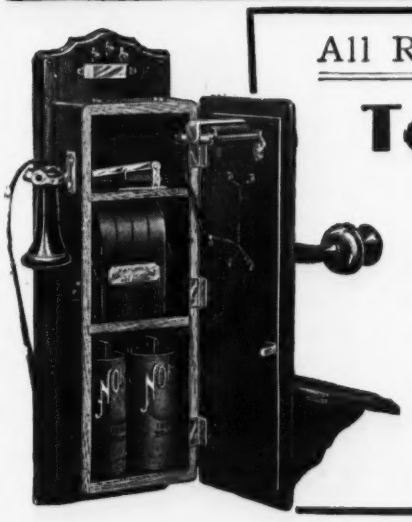

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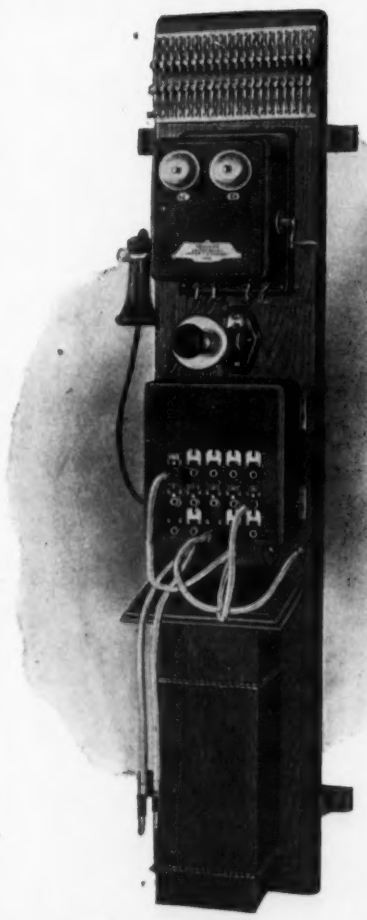

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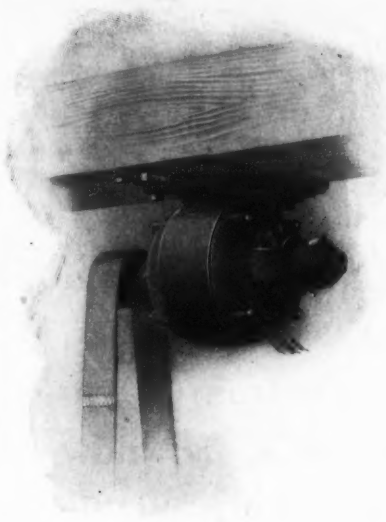

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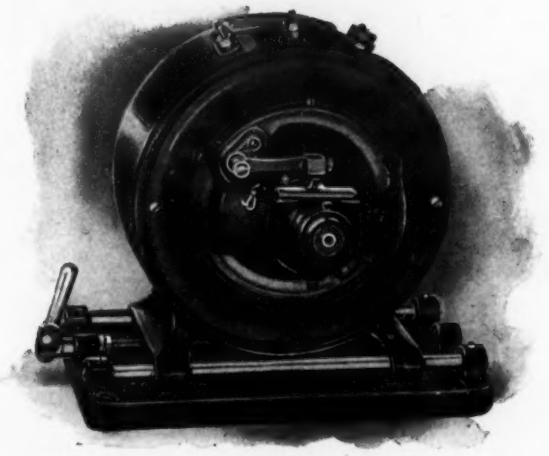

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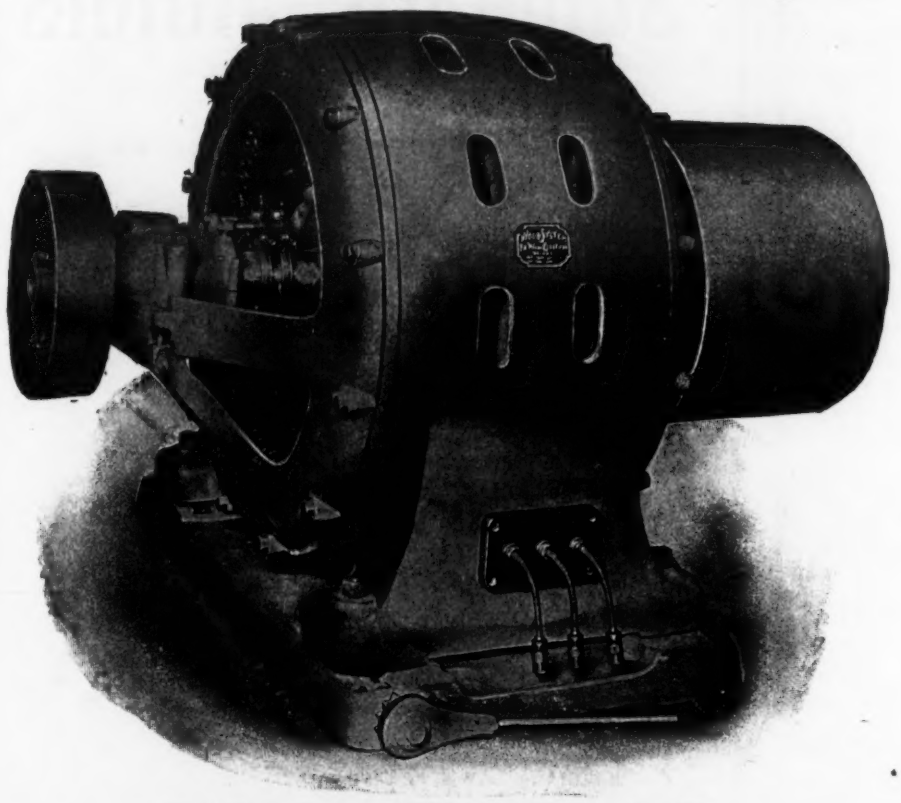

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